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March 18, 2010

Forest Plan Revision Team
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RE: Comment on Notice of Intent to Prepare an Environmental Impact Statement for Revision of Coronado National Forest Land and Resource Management Plan

Please accept comment from the Center for Biological Diversity ("Center") regarding the Notice of Intent ("NOI") to prepare an environmental impact statement ("EIS") for revision of the Coronado National Forest ("CNF") Land and Resource Management Plan ("Forest Plan"). 75 Fed. Reg. 4340 (Jan. 27, 2010).

The Center is a non-profit, public interest organization dedicated to the protection of native species and their habitats through science, policy and law. The Center has over 240,000 members and on-line activists in Arizona and the United States who maintain long-standing interests in the CNF and native species that exist there.

This comment incorporates by reference prior comments dated March 5, 2009 regarding desired conditions in the current plan revision. It responds in greater detail to the "need for change" statements in the NOI that are based on a Comprehensive Evaluation Report, which incorporates and is updated by findings of the following documents:

- Analysis of the Management Situation.
- Ecological Sustainability Report.
- Economic and Social Sustainability Assessment.
- Resource Evaluations.

Initially, however, we discuss requirements of the National Forest Management Act ("NFMA"), National Environmental Policy Act ("NEPA") and Endangered Species Act ("ESA") that must be observed as the Forest Service proceeds with the forest plan revision.

Please note that the NFMA planning regulations now in effect contain "transition" provisions allowing the Forest Service to initiate forest plan revision under rules that were effective prior to November 9, 2000. *See* 36 C.F.R. § 219.35(b); 74 Fed. Reg. 67059 (Dec. 18, 2009). The NOI states that the Forest Service "elected to use the provisions of the 1982 planning rule" in the current forest plan revision. 75 Fed. Reg. 4342 (Jan. 27, 2010). Therefore, the balance of this letter cites the 1982 planning regulations as published (47 Fed. Reg. 43037 (Sept.

30, 1982)) and revised as of July 1, 2000 – all further references to part 219 of chapter 36 in the Code of Federal Regulations reflect this assumption.

NFMA Requirements

(1) Standards and guidelines

NFMA directs the Secretary of Agriculture to issue regulations that "shall … incorporate the standards and guidelines required by this section in plans for units of the National Forest System…" 16 U.S.C. § 1604(c). NFMA requires "standards" for timber and transportation management as well as public participation in local forest plans. *See id*. §§§ 1604(f); 1604(m); 1608(c); 1612(a).

The 1982 planning regulations implementing NFMA state, "Plans guide all natural resource management activities and establish management standards and guidelines for the National Forest System. They determine resource management practices, levels of resource production and management, and the availability and suitability of lands for resource management." 36 C.F.R. § 219.1(b). Standards and guidelines in forest plans must be "qualitative and quantitative." *Id*. at § 219.1(b)(12). Forest plans must establish "standards and requirements by which planning and management activities will be monitored and evaluated." *Id*. § 219.5(a)(7). Additionally, plans must define reasons for management practices chosen for each vegetation type and circumstance. *See id*. § 219.15.

We propose reasonable and specific standards and guidelines regarding water, fisheries, roads, forest and wildlife below that should be considered and analyzed in the forthcoming environmental impact statement.

(2) Timber suitability

The CNF Forest Plan must assure suitability of lands where it allows timber production. *See* 16 U.S.C. § 1604(e). Timber suitability determinations "shall … be embodied in appropriate written material, including maps and other descriptive documents, reflecting proposed and possible actions, including the planned timber sale program and the proportion of probable methods of timber harvest within the unit necessary to fulfill the plan." *Id*. § 1604(f)(2). The Forest Service's responsibility under NFMA to plan for multiple uses necessarily means that not all lands are available for all purposes. *See id.* § 1604(g)(3)(E) (Forest Service must ensure that timber will be harvested from National Forest System lands only where, for example, "(i) soil, slope, or other watershed conditions will not be irreversibly damaged…"); *also see Southeast Conference v. Vilsack*, 08-1598 (D. D.C., Feb. 17, 2010). In developing forest plans, the Forest Service:

> shall identify lands within the management area which are not suited for timber production, considering physical, economic, and other pertinent factors to the extent feasible, as determined by the Secretary, and shall assure that, except for salvage sales or sales necessitated to protect other multiple-use values, no timber harvesting shall occur on such lands for a period of 10 years. Lands once identified as unsuitable for timber production shall continue to be treated for reforestation purposes,

> particularly with regard to the protection of other multiple-use values. The Secretary shall review his decision to classify these lands as not suited for timber production at least every 10 years and shall return these lands to timber production whenever he determines that conditions have changed so that they have become suitable for timber production.

Id. at 1604(k). Furthermore, the 1982 NFMA regulations state that timber suitability designations in forest plans must apply cost-benefit analysis and "stratify" National Forest Lands by allowable timber management intensity:

> For the purpose of analysis, the planning area shall be stratified into categories of land with similar management costs and returns. The stratification should consider appropriate factors that influence the costs and returns such as physical and biological conditions of the site and transportation requirements. This National Forest System Land Management Planning Environmental Impact Statement analysis shall identify the management intensity for timber production for each category of land which results in the largest excess of discounted benefits less discounted costs and shall compare the direct costs of growing and harvesting trees, including capital expenditures required for timber production, to the anticipated receipts to the government, in accordance with Sec. 219.12 and paragraphs (b)(1) through (b)(3) of this section.

36 C.F.R. § 219.14(b). Historically, the Forest Service has met this requirement by dividing the ASNF into discrete land use zones, or "management areas," each of which set forth standards and guidelines governing site-specific multiple use activities. This approach accords with the Forest Service's statutory responsibility under NFMA to "provide for multiple use and sustained yield of the products and services of units of the National Forest System." 16 U.S.C. § 1604(e).

In addition to rendering findings regarding timber suitability for specific portions of the CNF where that use is deemed appropriate in the revised plan, the Forest Service also must review classification of lands previously designated as unsuitable for timber production. *See* 16 U.S.C. § 1604(k); 36 C.F.R. § 219.14(b). It is not sufficient merely to list lands that previously were designated suitable or unsuitable and carry forward those designations into a revised forest plan without further analysis and comparison of alternatives, including alternatives that would significantly reduce the extent of lands deemed suitable for programmed timber production.

NEPA Requirements

NEPA is "our basic national charter for protection of the environment." 40 C.F.R. § 1500.1(a). The statute "is intended to help public officials make decisions that are based on understanding of environmental consequences, and take actions that protect, restore, and enhance the environment." *Id*. at 1500.1(c). In light of these purposes and policies, it would be inconceivable for the Forest Service not to address and disclose the real threats to the CNF resulting from the scientifically recognized changes in climate and the potential implications on natural resource availability for multiple uses over the life of the revised forest plan. *See* 42 U.S.C. § 4331(b) (federal agencies have a continuing responsibility to use all practicable means to "fulfill the responsibilities of each generation as trustee of the environment for succeeding generations.").

(1) Environmental impact statement

"NEPA requires federal agencies to prepare an environmental impact statement for any action that will significantly affect the environment." 42 U.S.C. § 4332(C). The EIS must consider (i) the environmental impact of the proposed action, (ii) any adverse environmental effects which cannot be avoided should the proposal be implemented, (iii) alternatives to the proposed action, (iv) the relationship between local short-term uses of the environment and the maintenance and enhancement of long-term productivity, and (v) any irreversible and irretrievable commitments of resources which would be involved in the proposed action would it be implemented. *Id*. The EIS "ensures that the agency, in reaching its decision, will have available, and will carefully consider, detailed information concerning significant environmental impacts; it also guarantees that the relevant information will be made available to the larger [public] audience that may also play a role in both the decision-making process and implementation of that decision." *Robertson v. Methow Valley Citizens Council*, 490 U.S. 332, 349, 109 S.Ct. 1835, 1845 (1989).

Forest plan standards and guidelines directly affect site-specific project design and indirectly affect implementation of project-level activities. *See* 36 C.F.R. § 219.3(b); FSH 1909.12.11.13 and1909.12.11.16 (W.O. Interim Directive No. 1909.12-2008-2, Nov. 17, 2008). Plans governing subsequent actions are environmentally meaningful decisions and result in effects that must be considered and disclosed under NEPA. *See Idaho Conservation*, 956 F.2d at 1516; *Salmon River Concerned Citizens v. Robertson*, 32 F.3d 1346, 1355 (9th Cir. 1994); *Resources Ltd. v. Robertson*, 35 F.3d 1300, 1303 (9th Cir. 1994).

(2) Purpose and need

The EIS must clearly state and justify a purpose and need for changing the existing forest plan as amended, including reasons why current direction is inadequate to meet desired conditions and objectives. *See* 40 C.F.R. § 1502.13; *also see* 36 CFR § 219.12(b). The CER notes several changes in ecological and socio-economic conditions that occurred after adoption of the current forest plan in 1986, several of which were specifically addressed by forest plan amendments. Such changes that now merit consideration include consequences of climate change, altered fire regimes, impaired soil productivity, reduced water availability, threatened and endangered wildlife population viability, and the collapse of an integrated forest products industry, among other factors.

(3) Alternatives

The alternatives section is the "heart" of an EIS. 40 C.F.R. § 1502.14; *see also* 42 U.S.C. § 4332(2)(E). As it considers the proposed action, the Forest Service must "[r]igorously explore and objectively evaluate all reasonable alternatives." *Id.* at § 1502.14(a); *see also* 36 C.F.R § 219.12(f). The EIS must present environmental impacts of the proposed action and reasonable alternatives "in comparative form, thus sharply defining the issues and providing a clear basis for choice among options by the decision-maker and the public." 40 C.F.R. § 1502.14. The NEPA process must "identify and assess the reasonable alternatives to proposed actions that will avoid or minimize adverse effects of these actions upon the quality of the human environment." *Id*. at § 1500.2(f).

The Forest Service is also directed to consider a "no action" alternative. *Id*. at § 1502.14(d). Regardless of what course of action is considered to be the "no action" alternative, existing forest plan standards and guidelines as amended must be fully assessed as a reasonable alternative to the proposed action. The existing CNF Forest Plan has been in effect for over two decades, never was found by a court to be improper or illegal, and provides an established and well-understood benchmark by which to assess effects of other alternatives.

The Forest Service should consider an action alternative that responds to changes in the global climate due to the increased atmospheric concentration of greenhouse gases (Alley et al. 2007, Clark and Weaver 2008). Climate change will have significant if uncertain direct, indirect and cumulative impacts to CNF lands and resources over the life of the revised forest plan, regardless of what course of action the Forest Service selects (Seager et al. 2007). At a minimum, one reasonable alternative should provide a substantial increase in protection for plant and animal species that exist on national forest lands. NFMA requires provision for the diversity of plant and animal communities based on the suitability and capability of the land. 16 U.S.C. § 1604(g)(3)(B). Scientists including Forest Service researchers acknowledge climate change as a key threat to biodiversity (Malcom et al. 2006, Matthews et al. 2004). Due to uncertainties regarding impacts of climate change on biodiversity and the clear mandate of NFMA to provide for diversity, the Forest Service must consider and fully analyze an action alternative that errs on the side of ecological caution (a "no-regrets strategy") by offering a safe harbor and refuge for fish and wildlife even to the expense of competing multiple use activities, such as programmed livestock grazing and timber production.

Please consider a full range of reasonable alternatives including, at the very least: (1) an alternative based on existing standards and guidelines in the amended CNF Forest Plan, and (2) a substantially more protective alternative that considers the magnitude of climate change and provides additional protection for fish and wildlife species that use or depend upon CNF lands.

(4) Affected environment

The EIS on forest plan revision must "describe the environment of the area(s) to be affected or created by the alternatives under consideration." 40 C.F.R. § 1502.15. This should include, at a minimum: (1) the present status and distribution of sensitive, threatened and endangered species that use or depend on CNF lands; (2) the current condition of rivers, streams, wetlands and aquatic habitats; (3) the amount and distribution of remaining old growth forest; (4) the extent and impacts of invasive species; (5) a description and assessment of the existing network of roads and trails; (6) an assessment of cumulative livestock grazing impacts; (7) an assessment of cumulative fire exclusion and suppression impacts; (8) the status of minerals development; and (9) the extent of past timber management.

A. Climate change

Atmospheric concentrations of greenhouse gases clearly influence global and regional climate systems (Alley et al. 2007, Seager et al. 2007). In assessing and describing the affected environment, the Forest Service must consider and disclose the extent and degree to which climate change affects CNF lands and resources. Climate change likely will have significant if unknown effects on biodiversity, forests and water availability (Malcolm et al. 2007, Millar et al. 2007). It already has begun to influence the survival, abundance and distribution of forest vegetation at community and landscape scales in the western United States (van Mantgem et al. 2009). Anticipated temperature increases above "pre-settlement" and current baseline levels that are "locked in" due to existing atmospheric greenhouse gas concentrations may shift the geographic range of some forest species and undercut the viability of others (Jones et al. 2009, Stephenson et al. 2006).

B. Range of variability

Climate change complicates the definition and selection of desired conditions and management outcomes given statutory mandates. Supporting analyses for the forest plan revision apply the "historical range of variability" ("HRV") concept to base comparisons of current and desired ecological conditions on CNF lands. Understanding the spatial and temporal contexts in which ecosystems function is critical to framing a coherent management strategy (Landres et al. 1999). It is generally accepted that historical ecosystem structure, composition and function should inform ecological restoration where that is an appropriate management emphasis (SER 2004). In one view, HRV characteristics are desirable not because they are historical, but because they are thought to be "self-perpetuating and resilient" to natural processes like fire (Arno and Fiedler 2005:39).

The range of conditions that would sustain adapted ecological functions and biological diversity, including an active fire regime in ponderosa pine and mixed conifer forests, would constitute appropriate "reference conditions" that frame goal setting and "desired conditions." Explicitly framed reference conditions account for desired forest structure, composition and function at multiple spatial and temporal scales help to (1) determine what factors cause ecological degradation, (2) identify what needs to be done to restore an ecosystem, and (3) inform criteria that measure success of restoration treatments (SER 2004).

However, reliance on HRV for reference conditions – or "desired conditions" – overlooks significant and possibly irreversible cumulative environmental shifts that have occurred since European settlement (Flannigan et al. 2000, Frederici 2003, Johnson and Duncan 2007). Climate change, landscape fragmentation and exotic species invasions preclude forest ecosystems from realizing settlement-era structural or compositional patterns even with active restoration oriented to HRV conditions (McGlone et al. 2009, Noss et al. 2006). Johnson and Duncan (2007) proposed updating the HRV concept to a "future range of variability" that accounts for ecological change and recognizes that a return to historical conditions is not achievable or sustainable. Understanding how forests adapt to climate over longer timescales than are commonly used in an HRV-focused approach can inform management strategies that support adaptation to uncertain future conditions imposed by changes in climate and landscape pattern (Stephenson et al. 2006).

C. Fire ecology

Increased atmospheric concentrations of greenhouse gases are likely to change the potential extent and severity of wildland fires in western North America (Westerling et al. 2006). Increased frequency, extent and severity of unplanned fires may attend climate warming and drought (Running 2006, Gedaloff et al. 2005). The EIS must assess more than the degree of fire regime departure from a narrowly-defined historical condition (i.e., "fire regime condition class") and disclose implications of climate change on wildland fire and management options in the future. Natural fire process is centrally important to restoration of ponderosa pine and mixed conifer forests (Allen et al. 2002, Cortina et al. 2006, Falk 2006). The active function of natural fire process in the future can regulate ecosystem structure and composition to "re-establish a new dynamic equilibrium" and track climate effects on vegetation and landscape pattern in real time (Falk et al. 2006:142).

D. Recreation

The EIS must explore and disclose ongoing and expected impacts of climate change on the millions of recreational users of the National Forest System. The CNF is one of the most heavily used of all National Forests for dispersed recreation in the Southwestern Region

E. Aquatic ecosystems

The Forest Service should analyze and disclose in the EIS what it knows about the existing condition of aquatic ecosystems and associated species on CNF lands, particularly ESA-listed fish populations.

(5) Environmental effects

The "environmental consequences" section of an EIS "forms the scientific and analytic basis" for the comparison of alternatives. 40 C.F.R. § 1502.16. This discussion must include "the environmental impacts of the alternatives including the proposed action, any adverse environmental effects which cannot be avoided should the proposal be implemented, the relationship between short-term uses of the environment and the maintenance and enhancement of long-term productivity, and any irreversible or irretrievable commitments of resources which would be involved in the proposal should it be implemented." *Id*. This section must include discussions of both direct and indirect effects and their significance, along with the environmental effects of the alternatives. *Id*.; *also see* 36 C.F.R. § 219.12 (g). The level of detail in an EIS may depend on the nature and scope of the proposed action (*see California v. Block*, 690 F.2d 753, 761 (9th Cir. 1982)), but must provide sufficient detail to foster informed decision-making. *See Citizens for Better Forestry v. U.S. Dep't of Agriculture*, 481 F. Supp. 2d 1059, 1086 (N.D. Cal. 2007). An EIS must include a "reasonably thorough discussion of the significant aspects of the probable environmental consequences." *N. Alaska Envtl. Ctr. v. Lujan*, 961 F.2d 886, 890 (9th Cir. 1992) (quoting *Block*, 690 F.2d at 761).

Forest plan revision will result in an actual, physical effect on the environment. *Citizens for Better Forestry v. U.S. Dept. of Agriculture*, 341 F.3d 961, 973 (9th Cir. 2003). Lowering environmental standards in a forest plan will result in lower environmental standards at the site-specific level. *Id*. at 975. Pursuant to NEPA, the Forest Service must analyze and disclose the direct, indirect and cumulative environmental effects of the proposed action in an EIS.

A. Fish and Wildlife

The 1982 NFMA regulations provide for the persistence of fish and wildlife on National Forest Lands. They require the Forest Service to manage fish and wildlife habitat to maintain viable populations of existing fish and wildlife species. *See* 36 C.F.R. § 219.19. In order to ensure viable populations, the agency must provide for a minimum number of reproductive individuals and the habitat required for well distributed individuals to interact with others in the planning area. *Id.* Moreover, in order to estimate potential effects on fish and wildlife populations, the Forest Service must identify "management indicator species," and monitor their population trends. *Id*. Additional protection is provided to threatened and endangered species and their habitat. *Id*.

The revised forest plan must apply the 1982 viability requirement as a starting point to develop mandatory protections for fish and wildlife species that exist on CNF lands. To be useful and meaningful, the Forest Service's analysis of the environmental consequences of the proposed action should explicitly apply the viability requirement of the 1982 planning rule. The current ASNF Forest Plan states at page 62: "Maintain habitat for viable populations of all existing vertebrate wildlife species." It defines "viable population" as one "of sufficient size to maintain its existence over time in spite of normal fluctuations in population levels." *Id*. at 225.

The Forest Service indicates in the ESR document referenced above which the NOI characterizes as "appropriate for continued use in the revision process," that it will attempt to meet its statutory and regulatory obligations to ensure fish and wildlife viability by managing habitat at broad spatial scales for three groups of species that it says "are the basis for the species diversity component of ecological sustainability." ESR at 24. The ESR proposes a novel and unexplained "screening" process that avoids focused analysis of particular fish and wildlife species, their populations, and prospects for viability or recovery. A careful reader of the ESR cannot determine from the information provided what terrestrial species are present on the CNF, let alone how any were selected for "risk analysis," or how new "desired conditions" and "design criteria" may affect them and their critical habitats.

The Forest Service's proposed use of a habitat-proxy approach to managing taxonomic groups of species (*See* ESR Table 10) has rarely been tested in any context (Martino et al. 2005). Lawler and others (2003) compared the ability of seven indicator groups (freshwater fish, birds, mammals, freshwater mussels, reptiles, amphibians, including at-risk species of those taxa) to provide protection for other species in the Middle Atlantic region of the United States. No taxonomic group provided protection for more than 58% of all other at-risk species (Lawler et al. 2003 – Table 2 below). This failure to cover at-risk species through a taxon-based or habitat-proxy approach is linked to their rarity. Species with more restricted ranges are less likely to be protected by management of habitat at taxonomic scales than more widespread species. Lawler and others (2003) found that at-risk species themselves performed relatively well as an indicator group, but still covered an average of just 84% of other species. “The test for whether the habitat proxy is permissible … is whether it reasonably ensures that the proxy results mirror reality.” *Gifford Pinchot Task Force v. U.S. Fish and Wildlife Serv.*, 378 F.3d 1059, 1066 (9th Cir. 2004).

In addition to this overlap problem and uncertainty regarding the effectiveness of a “target species” approach to conserving ecosystem diversity in general and species population viability in particular, other sources of uncertainty in the Forest Service’s screening approach also must be accounted for in its wildlife risk analysis, including: (1) species-specific habitat association assumptions, (2) validity of potential natural vegetation modeling discussed above, and (3) cumulative effects of nonfederal activities. Examples of the latter consideration include competition from and genetic impacts of non-native and hatchery fish, and habitat conditions on state and private lands, which generally are inadequate to support well-distributed and robust populations of fish and wildlife.

Consultation with FWS on a species-specific basis will partially address uncertainty regarding habitat associations and contribute to adaptive management that can help forestall extinctions and support population viability and recovery as climate change alters habitat availability and suitability for various fish and wildlife species in the CNF (Schultz 2008). The Center strongly advises against grouping ESA-listed species with “ecosystem diversity characteristics” as a substitute for the Forest Service’s clear obligation under ESA to consult on potential effects of forest plan revision to listed species and their habitats. The ESR lacks basic information about what ESA-listed species exist on the CNF, what their habitat requirements are, or how management may help or preclude their recovery.

The 1982 NFMA regulations also require the Forest Service to prepare “regional guides” for each Forest Service region to “provide standards and guidelines for addressing major issues and management concerns which need to be considered at the regional level to facilitate forest planning.” 36 C.F.R. § 219.8(a) (1982). This provision of the 1982 regulations was eliminated by the Forest Service’s attempts in 2000, 2005, and 2008 to revise the NFMA regulations. If regional guides are again proposed to be eliminated, the Forest Service must assess the proposed elimination of these previously required regional guides and the potential consequences to wide ranging and migratory species that need to be considered and addressed at the regional level.

B. Old Growth Forest

Past timber harvest destroyed old growth forests at upper elevations in the CNF and many wildlife species that depend on these forests, including Mount Graham red squirrel and Mexican spotted owl, now struggle for survival. The mandatory viability requirement of the 1982 planning regulations require the Forest Service to adopt mandatory and quantitative standards in forest plans that protect old growth forests and associated wildlife, as exist in the current CNF Forest Plan. Any changes to existing standards and guidelines must include analysis of impacts to old growth forest and associated species, including how the Forest Service will satisfy the NFMA diversity requirement and ESA prohibition against species jeopardy.

C. Impacts of Eliminating or Revising Prior Standards

The 1982 planning regulations include a number of mandatory and quantifiable standards referred to as "management requirements," including numeric limits on the size of management-created forest openings and stream side buffers. 36 C.F.R. § 219.27; *also see* 16 U.S.C. § 1604(g)(3). If any of these standards would be eliminated or revised, the EIS must assess potential environmental impacts, including potential jeopardy to ESA-listed species and/or violation of state or federal water quality standards.

The Forest Service is not revising the CNF forest plan on a blank slate. It must analyze the proposed action and alternatives in relation to existing standards and guidelines and their explicitly stated purposes ("no-action alternative"). In proposing new standards and guidelines, the Forest Service also proposes to eliminate, replace or revise previous direction for site-specific management.

D. Impacts of Multiple Uses on Climate Change

The Intergovernmental Panel on Climate Change, made up of over 1,000 scientists from over 100 countries, recently concluded that it is "very likely" (90 percent probability) that human activities are the main cause of global warming (Alley et al. 2007). Potential environmental consequences that may be caused by climate change are highly significant (Malcolm et al. 2007, Millar et al. 2007, Seager et al. 2007). In its forthcoming EIS, the Forest Service must assess and disclose the potential contribution of multiple resource uses and management activities that may contribute to or compound ongoing changes to the regional and global climate system including, but not limited to: (1) groundwater extraction; (2) surface water diversions and withdrawals; (3) continued use of existing roads and trails; (4) development of new roads and trails; (5) livestock grazing; (6) fire and fuel management; (7) minerals development; (8) logging; and (9) spread of invasive species.

Forests are the most significant terrestrial stores of carbon, and in fact may slow global warming by storing and sequestering carbon. "Forest plants and soils drive the global carbon cycle by sequestering carbon dioxide through photosynthesis and releasing it through respiration." *See* Union of Concerned Scientists, "*Recognizing Forests' Role in Climate Change*," www.ucsusa.org. Through photosynthesis, plants capture carbon dioxide and convert it to plant matter that then feeds the base of the entire planetary food chain (Heiken 2009). Old-growth forests are able to store massive amounts of carbon in their trunks as well as in the soil (Luyssaert et al. 2007). When forests are degraded or logged in timber sales or fuel reduction projects, their stored carbon is released back into the atmosphere during harvest and through respiration, thus becoming net contributors of carbon to the atmosphere (North et al. 2009).

Forest management can help to mitigate global warming in at least two key ways: (1) conserving existing forests to avoid emissions associated with forest degradation or clearing; and (2) sequestration by increasing forest carbon absorption capacity - occurring primarily by planting trees or facilitating the natural regeneration of forests. *Id*. In other words, to help our forest store more carbon, and thereby alleviate the leading cause of global warming, we need to let our forests grow. *Id*. The Forest Service must consider and disclose the potential environmental consequences and climate change implications resulting from any anticipated continued commercial harvest of timber on our national forests.

The Forest Service must also consider the anticipated continuation of any livestock grazing and its contribution to climate change. A recent report from the Food and Agriculture Organization of the United Nations found that livestock are responsible for eighteen percent of greenhouse gas emissions, representing a larger share than that of transport. *See* Steinfeld, H.; Gerber, P.; Wassenaar, T.; Castel, V.; Rosales, M.; Haan, C., "*Livestock's Long Shadow, Environmental Issues and Options*," (2006). Livestock grazing is widespread across the National Forest System in the western United States, and the contribution of this grazing on climate change must be assessed and disclosed.

Fire is a fundamental component of Earth's natural carbon cycle, with a functional role that pre-dates human existence. Ecosystems in the CNF are adapted to the active functioning of natural fire process. In those ecosystems, fire exclusion may not yield long term reduction of greenhouse gas emissions compared to re-establishment and maintenance of a functional fire regime (AFE 2009). Prescribed burning is a risk-reduction management tool that can be used to mitigate undesirable impacts of unplanned wildfires. Carbon emissions from prescribed burning typically are much lower than those stemming from unplanned wildfires (AFE 2009). Therefore, the Forest Service should consider and disclose benefits and potential liabilities of using prescribed fire at broad spatial scales to reduce risk, provide ecosystem services and regulate greenhouse gas emissions from forest management activities.

The EIS must also consider any expected oil and gas development on national forests. The ultimate burning of these fossil fuels would further increase global warming pollution, which needs to be considered and disclosed in this EIS. Similarly, the EIS must also address the emerging major issue of biomass and how the expanding biomass industry could affect the national forests and climate change impacts.

ESA Requirements

The plan revision will affect, and is likely to adversely affect, threatened or endangered plants and animals. Therefore, the Forest Service is obligated to formally consult with the U.S. Fish and Wildlife Service ("FWS") to ensure that plan revision "is not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of [critical] habitat of such species." 16 U.S.C. § 1536(a)(2); 50 C.F.R. § 402.14(a).

Revision of standards and guidelines for management of Mexican spotted owl ("MSO") and its habitat, for example, may jeopardize the threatened bird if consultation is deferred to site-specific proposed actions, or if the revised plan fails to implement the 1995 Recovery Plan. Prior forest plan amendments that included standards and guidelines for MSO habitat underwent formal ESA consultation to verify that no jeopardy would result. The same is true regarding other threatened and endangered species that exist on the CNF.

The Forest Service recently maintained that it would not consult FWS on forest plan revisions as a matter of policy. *See* Sensitive Species and Endangered Species Act Section 7 Consultation Policy for National Forest System Land Management Planning Under the 2008 Planning Rule, 73 Fed. Reg. 46243 (Aug. 8, 2008) (stating that forest plan revisions "typically will have no effect on listed species or designated critical habitat" under the ESA, and that plan revision is "not an action within the meaning of the ESA"). The Ninth Circuit Court of Appeals unequivocally holds that forest plans are subject to ESA consultation. *Pacific Rivers Council v. Thomas*, 30 F.3d 1050, 1051-52 (9th Cir. 1994); *also see Citizens for Better Forestry*, 481 F. Supp. 2d at 1095 ("The Ninth Circuit has undeniably interpreted ESA to require consultation on programmatic actions and rules, including consultation at the planning stage, not just the site-specific stage.").

Need for Change

(1) Climate

Abrupt climate change is imminent or underway in the southwestern United States (Cook et al. 2008, Seager et al. 2007). It is caused primarily by the release of greenhouse gases (most notably carbon dioxide ("CO2")) from the burning of fossil fuels by humans, and it may accelerate if our use of fossil fuels is not substantially reduced (Alley et al. 2007). Climate changes historically alter forests (Whitlock et al. 2003) and inevitably will cause further changes both directly—through the direct responses of trees to altered temperature and moisture—and indirectly—through shifting natural disturbance regimes, which can be expected to increase in extent, duration, and severity (Bachelet et al. 2007, Dale et al. 2001, Field et al. 2007, Running 2006, Westerling et al. 2006). Some changes may prove beneficial to human values, but many will adversely affect nutrient cycling, soil productivity, water flows, and biological diversity. Early actions to mitigate climate change will be more beneficial than later efforts.

Forests will be affected by climate change, but they also may help to mitigate it. Forests influence the rate and extent of climate change by absorbing CO2 from the atmosphere and storing it in wood and soils, or by releasing CO2 to the atmosphere (Barnes et al. 1998). CO2 is released whenever land is converted to nonforest uses or disturbed by logging, burning, or outbreaks of insects and disease (Luyssaert et al. 2007). All forests both absorb and release CO2, and the relative balance between the two processes determines whether a forest is a source or sink of CO2. Forests are not the solution to the potential threat of runaway and catastrophic climate change, but they can make important contributions. They will be most effective in mitigating emissions in the near term (the next decade or two; the approximate life of the revised A-S forest plan), which climate scientists have identified as a crucial period if we are to avoid potentially catastrophic climate changes at a global scale (Clark and Weaver 2008, Hansen 2008).

The most important thing forest managers can do to mitigate climate change is to protect large, old-growth and mature trees from timber harvest and associated soils from mechanical disturbance (Carey et al. 2001, Luyssaert et al. 2007, Paw U et al. 2004). Preservation of what little old-growth forest remains in the A-S forests may have a larger effect on atmospheric carbon cycles than promotion of regrowth (Schulze et al. 2000). Although increased atmospheric concentrations of CO2 may, under certain conditions, enhance rates of photosynthesis, tree growth, and soil carbon storage (Houpis et al. 1999, Xu et al. 2009), prolonged and intensified drought conditions likely to prevail in the foreseeable future (Seager et al. 2007) also may limit ponderosa pine recruitment (Savage et al. 1996). "There remains uncertainty in how strong the projected drying in the Southwest will be, an uncertainty that includes the possibility that it will be more intense than in the model projections" (Cook et al. 2008:199-200; also see North et al. 2009). Therefore, removal of large, old-growth and mature trees may constitute an irretrievable commitment of resources.

North and others (2009) compared fuel treatment effects on carbon stocks and releases in replicated plots before and after treatment, and against a reconstruction of active-fire stand conditions for the same forest in 1865. Total live tree carbon was substantially lower in modern fire-suppressed conditions (and all of the treatments) than the same forest under an active-fire regime. Although fire suppression has increased stem density, current forests have fewer very large trees, reducing total live tree carbon stocks and shifting a higher proportion of those stocks into small-diameter, fire-sensitive trees. Thinning followed by prescribed burning released 70% more carbon into the atmosphere than prescribed burning alone and contributed significant additional emissions in subsequent milling waste of wood products. All treatments reduced fuels and increased fire resistance but most of the gains were achieved with understory thinning with only modest increases in the much heavier overstory thinning. North et al. (2009) suggest modifying current treatments to focus on reducing surface fuels, actively thinning the majority of small trees, and removing only fire sensitive species in the merchantable, intermediate size class. These changes would retain most of current carbon pool levels, reduce prescribed burn and potential future wildfire emissions, and favor stand development of large, fire-resistant trees which can better stabilize carbon stocks.

(2) Aquatic ecosystems

The ESR and CER documents prepared by the Forest Service drop hints that ecological conditions in aquatic habitats on the CNF are severely degraded. According to the ESR on page 17,

> Current water quality is almost certainly degraded compared with reference conditions. The majority of pollutants are from activities that did not exist in the reference timeframe; specifically, mining, grazing, hydrologic modification (channelization), pesticide use, recreation, roads, and crop production. Within the Coronado NF, the trend for all water quality constituents is either static or up (improving).

The Forest Service concedes degradation to aquatic habitats resulting from numerous cumulative threats distributed over space and time, yet asserts without any analytical basis whatsoever that conditions are "static," or "improving." The EIS will bear a high factual burden to justify such seemingly arbitrary and capricious conclusions.

Water diversions, groundwater depletion, management impacts to riparian and upland habitats, and general declines in physical and biological conditions including water temperature, hydrologic flows and sediment regimes contribute to current degraded conditions. Such radical physical alterations to the aquatic environment cause changes in ecosystem organization. Key ecosystem components and functions may be eliminated and processes leading to ecological recovery may be arrested (Steedman and Regier 1987). There may be reduced efficiency of nutrient cycling, changes in productivity, reduced species diversity, changes in the size distribution and life-history traits of certain fauna, increased incidence of disease, and increased population fluctuations with increasing levels of stress (Woodwell 1970, Odum 1985, Rapport et al. 1985, Moyle and Leidy 1992). Climate change poses additional potential to reduce water availability and habitat suitability for aquatic organisms (Seager et al. 2007).

An ecosystem approach is warranted to stop habitat degradation, maintain habitat and ecosystems that are currently in good condition, and to aid recovery of at-risk aquatic species and their habitat. Although federal land management cannot arrest all sources of fisheries decline and degradation of aquatic habitat, such as artificial stocking and non-native species invasions, the Forest Service can implement standards and guidelines to maintain and restore aquatic and riparian habitats on CNF lands. This approach is both prudent and necessary given the current perilous state of most native fish populations and other aquatic organisms, such as Chiricahua leopard frog.

Key physical components of a fully functioning aquatic ecosystem include complex habitats consisting of floodplains, banks, channel structure (*i.e.*, pools and riffles), water column and sub-surface waters. These are created and maintained by rocks, sediment, large wood and favorable conditions of water quantity and quality. Upslope and riparian areas influence aquatic systems by supplying sediment, large wood and water. Disturbance processes such as floods are important delivery mechanisms. Over time scales of one-to-1000 years, streams are clearly disturbance-dependent systems (Pringle et al. 1988). To maintain community viability throughout a large drainage basin, it is necessary to maintain features of the natural disturbance regime (*i.e.*, frequency, duration and magnitude) in different portions of a basin. Aquatic ecosystems consist of a diversity of species, populations and communities that may be uniquely adapted to these specific structures and processes (USDA 1993).

Spatial and temporal connectivity within and between watersheds is necessary for maintaining aquatic and riparian ecosystem functions (Naiman et al. 1992). A large river basin can be visualized as a mosaic of a terrestrial "patches" (Pickett and White 1985) or smaller watersheds linked by stream, riparian and sub-surface networks (Stanford and Ward 1992). Lateral, vertical and drainage network linkages are critical to aquatic system function. Important connections within basins include linkages among headwater tributaries and downstream channels as paths for water, sediment and disturbances; and linkages among floodplains, surface water and ground water systems (hyporheic zones) as exchange areas for water, sediment and nutrients. Unobstructed physical and chemical paths to areas critical for fulfilling life history requirements of aquatic and riparian-dependent species must also be maintained. Connections among basins must allow for movement between refugia (USDA 1993).

The Forest Service adopted an ecosystem approach to management of aquatic habitat and at-risk fisheries in a Record of Decision for federal lands in the Pacific Northwest. The Aquatic Conservation Strategy (“ACS”) of the Northwest Forest Plan designates Key Watersheds in large drainage basins that offer the highest quality aquatic habitat, which tend to be free of dams or host large areas of upland terrestrial habitat without roads, where recovery of at-risk aquatic organisms has the greatest likelihood of success. Key Watersheds are withdrawn from programmed timber harvest and increases of road density are prohibited. The ACS further designates Riparian Reserves on lands parallel to streams or in proximity to wetlands where the management emphasis is on maintenance and restoration of aquatic habitat. Standards and guidelines for active management of Riparian Reserves require that proposed actions meet nine discrete ACS Objectives related to physical, chemical and biological aspects of aquatic ecosystems.

In addition to establishing plan-level management areas, or land allocations, the ACS also requires the Forest Service to undertake watershed analysis at the scale of large drainage basins to account for critical factors including road density in riparian and upland habitats, vegetation cover, and basin-specific ecological processes that contribute to aquatic habitat quality. Active forest management in Key Watersheds and Riparian Reserves must be preceded and informed by watershed analysis.

Moreover, the ACS calls for restoration of aquatic ecosystems through active management that meets the ACS Objectives. Examples of restoration activities include road density reduction, removal of developments and grazing from floodplains and wetlands, and a prohibition on use of mitigation or planned restoration as a substitute for preventing degradation of existing high-quality aquatic habitat.

The Center strongly recommends that the Forest Service adopt an ecosystem approach to management of aquatic habitats in this forest plan revision. It is clear that existing standards and guidelines, even if fully funded and implemented, are inadequate to meet statutory and regulatory requirements to provide for fish and wildlife populations that depend on aquatic ecosystems. The Draft Plan would roll back virtually all of these standards and guidelines and replace them with discretionary guidelines related to in-stream water flows and placement of new roads. Thus, the Draft Plan would be found even more wanting than the existing CNF Forest Plan regarding NFMA requirements.

Road location, design, construction and engineering practices have improved over time, but few studies systematically and quantitatively evaluate whether newer practices result in lower erosion rates (Gucinski et al. 2001). Even with improved practices and mitigation, total accelerated erosion and sediment yields are still at least 50 percent or more than natural yields over time (Gucinski et al. 2001). This is a best-case scenario. Roads contribute more sediment to streams than any other land management activity (Gibbons and Salo 1973, Meehan 1991). Substantial increases in sedimentation are unavoidable even when the most cautious road construction methods are used (Gucinski et al. 2001, McCashion and Rice 1983). Roaded and logged watersheds in the same basin also feature significantly higher channel bed substrate embeddedness than do undeveloped watersheds (Gucinski et al. 2001).

Road-stream crossings inevitably cause major sedimentation, largely resulting from channel fill around culverts and subsequent road crossing failures (Furniss et al. 1991, Trombulak and Frissell 2000). Plugged culverts and fill slope failures frequently happen and lead to “catastrophic increases” in stream channel sediment (Weaver et al. 1995). Road-stream crossings create unnatural channel widths, slope and streambed form both upstream and downstream from the crossings, and these alterations of channel morphology can persist for long periods (Heede 1980). Channelized stream sections resulting from rip-rapping roads adjacent to stream channels are directly affected by sediment from side casting and road grading, and such activities can trigger fill slope erosion and failures (Gucinski et al. 2001).

Therefore, the Forest Service should consider and analyze an alternative in the forthcoming EIS that prohibits new road construction. In addition, it should consider and analyze an alternative that requires substantial reduction of road density forest-wide, prioritizing road removal in riparian areas associated with aquatic ecosystems.

(3) Vegetation

In its EIS, the Forest Service should explicitly define its use of the terms, “sustainable,” “appropriate,” “restore,” and “resilience” regarding vegetation in difference ecological communities. We discuss above reasons why blind reliance on an arbitrarily defined HRV condition is not inherently “sustainable” or “resilient” given ongoing climate change and the impossibility of achieving or sustaining pre-settlement conditions on CNF lands.

“Restoration” is an appropriate management objective for vegetation on CNF lands, and we would apply the Society for Ecological Restoration’s definition of “restoration” as “the process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed” (SER 2004:3). The word “assisting” is central to the definition. Fire exclusion, livestock grazing and logging in some ponderosa pine and mixed conifer forests of the Inland West may have altered ecological function such that existing systems are vulnerable to catastrophic loss and require active management to reduce fuels and restore adapted ecological processes including fire (Arno and Fiedler 2005, Hann et al. 1997). However, this idea is controversial because historical fire regimes are poorly understood, particularly where fire disturbance patterns vary in extent, timing, intensity and biological effects (Baker et al. 2006, Veblen 2003). In many cases, passive restoration including cessation of activities that degrade ecosystems (e.g., fire exclusion) may be sufficient to accomplish restoration (DellaSala et al. 2004). The EIS should establish criteria for active and passive restoration of forest vegetation accounting for the “future range of variability” (Johnson and Duncan 2007) of sustainable ecological conditions that necessarily attend climate change (Millar et al. 2007).

The Forest Service routinely uses coarse-scale fire regime condition classification of vegetation, fuel and disturbance to index landscape departure from historical fire regimes and identify lands at-risk of uncharacteristically severe fires that may impair ecosystem function (Hann and Bunnell 2001, USDA 2008:9). Such assessments characterize most ponderosa pine and mixed conifer forests, for example, as “condition class 3,” or severely altered from historical conditions (Schmidt et al. 2002). However, fire regime condition class poorly predicts actual wildland fire effects (Odion and Hanson 2006), and researchers demand convincing evidence of ecosystem departure from adapted disturbance regimes before ecologically unprecedented restoration interventions are undertaken (Gutsell et al. 2001).

Given that ecosystem management based on natural disturbance regimes “will always be somewhat uncertain” (Landres et al. 1999), conservation biologists urge precaution in decision-making about ecological restoration when systems thought to be degraded are not well understood (Noss and Cooperrider 1994). The precautionary principle counsels against actions than cannot be reversed later if the decision is wrong (Meffe and Carroll 1997). In this view, restoration should target areas most likely to benefit from active intervention (Brown et al. 2004). Need for restoration depends on ecological scale, disturbance history, vegetation characteristics and current conditions (Lindenmayer and Franklin 2002). The EIS on forest plan revision is the appropriate vehicle for a science-based, landscape-scale assessment of forest restoration need.

Large areas of the CNF remain little disturbed by human management and closely resemble conditions in which indigenous life evolved. Places retaining high degrees of ecological integrity generally host few if any roads. Those places function as reservoirs of biodiversity where passive restoration (*i.e.*, halting or foregoing activities that may cause ecological damage) and active use of wildland fire for resource benefits may offer the most ecologically sensible management approaches over time (DellaSala and Frost 2001). However, legitimate needs for more active restoration often exist in areas with high road densities, particularly at lower elevations where intensive human use history overlaps drier forest types that are most likely to have experienced functional alteration due to cumulative effects of fire exclusion, livestock grazing and logging (DellaSala et al. 2004).

Ecologists stress the importance of defining locally specific reference conditions to justify restoration goals and outcomes (White and Walker 1997). Descriptions of natural variation in ecosystems derived from historical ecology and their application as reference conditions to land management are matters of controversy (Swetnam et al. 1999). However, it is generally accepted that understanding historical ecosystem dynamics, structures and functions can provide useful information to guide restoration efforts (SER 2004). For additional discussion regarding reference – or desired – conditions for forest vegetation management, please refer to our comments on “Range of Variability” under the heading “Affected Environment” above.

The inherent complexity and dynamism of ecological systems render impossible accurate prediction of all consequences of restoration activities. Therefore, such projects initially should be confined to small spatial scales and accompanied by monitoring and evaluation sufficient to inform adaptive management (DellaSala et al. 2004). Monitoring facilitates impact assessment and tactical adaptation if treatments produce unintended or inadequate results (Lee 1993). Monitoring also empowers restoration practitioners to demonstrate contract compliance, educate stakeholders and elevate restoration discourse above faith-based forestry. Funding, complexity, training and commitment can pose formidable barriers to reliable effectiveness monitoring of ecological restoration (Elzinga et al. 1998). Consequently, there exists a need for streamlined monitoring protocols that simplify and improve efficiency of the task without compromising defensibility. The EIS on forest plan revision is an appropriate vehicle for proposing monitoring protocols that can be reliably implemented to support restoration-focused adaptive management.

The vast majority of old-growth forests in the proposed action area and throughout the southwest already have been cut over (Covington and Moore 1994). The ecological significance of old-growth forests and large trees is amply documented, whereas a scientific basis for logging large trees is lacking (Kaufmann et al. 1992, Friederici 2003). Large tree removal is <u>not</u>

necessary or beneficial to forest restoration at a landscape scale (Allen et al. 2002, Falk et al. 2006).

Stems larger than 16” dbh comprise only approximately three percent (3%) of live ponderosa pines in Arizona and New Mexico, according to Forest Inventory and Analysis (FIA) data (USDA 1999, USDA 2007). The same data indicate that more than eighty-two percent (82%) of ponderosa pine trees in Region 3 are currently smaller than 11” dbh; approximately ninety-six percent (96%) of ponderosa pines are smaller than 15-inches dbh; and less than one-tenth of one percent (.01%) of pines are larger than 21” dbh. Large snags, which provide critical wildlife habitat, comprise less than three percent (3%) of total snags on the landscape, and average about one large snag per eight acres (Nowicki and George 2004). Clearly, the size distribution of trees in the southwest is heavily skewed toward small-diameter trees and is dramatically different than historical conditions (Fulé et al. 1997). Given the extreme rarity of large-diameter trees and the overabundance of small trees, the harvest of trees larger than 16” dbh cannot be justified on ecological grounds (Allen et al. 2002).

A variety of factors other than logging threaten the remaining large trees in southwestern ponderosa forests. Prescribed fire treatments can damage tree roots and cause high levels of mortality among large trees (Sackett et al. 1996). Burning of pine stands with high surface fuel loading also can result in tree mortality (Hunter 2007), and fire treatments may leave trees susceptible to bark beetle infestation (Wallin et al. 2003). Additionally, large tree mortality has unintentionally resulted from mechanical thinning projects (Hunter 2007). Large snags and downed logs, which provide critical habitat for cavity-nesting birds, bats, small mammals, reptiles, amphibians and insects, are often destroyed by fuel reduction treatments (Hunter 2007). Any gains in new snags and downed logs as a result of vegetation treatments generally do not offset their loss at a landscape scale (Randall-Parker and Miller 2002). Hence, the continued existence of large trees and snags for purposes of old-growth function and adapted ecological processes is by no means assured. Considering their scarcity, as well as the unique services they provide, large trees should be preserved whenever possible. Because large trees are the most difficult of all forest structural elements to replace, logging them constitutes an irreversible environmental impact that is scientifically controversial in regards to its efficacy in fire hazard reduction and forest restoration (Covington 2000, Cortner 2003).

An upper diameter limit of 16-inches diameter on trees to be cut and removed in projects with purpose and need statements related to fuel management and ecological restoration is necessary to ensure preservation of rare large tree structure, critical wildlife habitat, forest health, and general aesthetics. Unless it is shown to be absolutely necessary to attain the purpose and need for action, no trees larger than 16” dbh should be harvested — this limit is simple to observe and widely accepted (Friederici 2003). Cutting and removal of large-diameter trees consistently proves to be a deal-breaker for many stakeholders, and we suggest that adopting a diameter cap will expedite fuel reduction and forest restoration treatments. Please refer to the series of Forest Service reports on *Small-Diameter Success Stories* (Livingston 2004, 2006, 2008) demonstrating social consensus and market opportunities for stewardship activities.

(4) Fire

Increased atmospheric concentrations of greenhouse gases are likely to change the potential extent and severity of wildland fires in many forests (Westerling et al. 2006). Increased frequency, extent and severity of unplanned fires may attend climate warming and drought (Running 2006, Gedaloff et al. 2005). The EIS must assess more than the degree of fire regime departure from a narrowly-defined historical condition ("fire regime condition class") and disclose implications of climate change on wildland fire and management options in the future. Natural fire process is centrally important to restoration of ponderosa pine and mixed conifer forests (Allen et al. 2002, Cortina et al. 2006, Falk 2006). The active function of natural fire process in the future can regulate ecosystem structure and composition to "re-establish a new dynamic equilibrium" and track climate effects on vegetation and landscape pattern in real time (Falk et al. 2006:142). In the absence of fire use on relatively short rotations compared to the suppression era, the Forest Service effectively manages the landscape for large scale, high intensity fires during extreme weather, creating unnecessary taxpayer expense and unacceptable risk to human life and resource values.

A distinguishing feature of ecologically resilient conifer forests is a prevalence of large trees that possess autecological characteristics (*e.g.*, thick bark, tall canopies) that predispose them to resist heat injury from fire (Arno 2000). Forests dominated by large trees also feature structural characteristics in the form of large down logs that tend to inhibit intense fire behavior (Graham et al. 2004). Large down trees can slow sub-canopy horizontal wind movement and fire spread (Countryman 1956), and their tendency to retain moisture can deprive fire of heat energy (Amaranthus 1989). Removal of large woody structure can diminish ecosystem resilience to fire (Brown et al. 2004, Omi and Martinson 2004, Agee and Skinner 2005, Noss et al. 2006).

The intensity of fire behavior and the severity of its effects partly depend on fuel properties and their spatial arrangement, in addition to local topography and prevailing weather. Fuel bed structure plays a key role in fire ignition and spread potential, and it is a central consideration in an effective fuel management strategy (Graham et al. 2004). The bulk density (weight within a given volume) of surface fuel consisting of grasses, shrubs, litter and dead woody material in contact with the ground influence frontal surface fire behavior (heat output and spread rate) more than fuel load (weight per unit area) (Agee 1996, Sandberg et al. 2001). High surface fireline intensity increases the likelihood of tree crown ignition and torching behavior (Scott and Reinhardt 2001).

The shrub and small tree fuel stratum also influences crown fire ignition and spread because it can feed surface fire intensity and serve as "ladder fuel" that facilitates vertical movement of fires from the ground surface into the forest canopy. The size of the spatial gap between the ground and tree crowns is a key determinant of crown ignition from a surface fire (Graham et al. 2004). Van Wagner (1977) demonstrates that crown fires ignite only after surface fires reach critical fireline intensity relative to the height of the base of crown fuels. In turn, crown ignition (*i.e.*, torching) can become a running canopy fire if its spread rate surpasses a canopy fuel density threshold that varies with slope angle and wind speed. Reducing hazard of active crown fire that spreads among trees independent of surface fire behavior generally requires heavy thinning of overstory trees to reduce canopy fuel density, depending on stand structure and degree of acceptable risk. The effectiveness of active management of forest structure to reduce hazard of active crown fire depends on the validity of crown bulk density calculations and estimates of extreme fire behavior conditions (Perry et al. 2004).

Omi and Martinson (2002) sampled several areas in the western United States where active vegetation management preceded wildfire to describe the effectiveness of fuel treatments on subsequent fire severity. The strongest correlation they report exists between crown base height and "stand damage," which they describe as a measure of severity. Importantly, crown bulk density does not strongly correlate with fire severity. According to the study,

> height to live crown, the variable that determines crown fire initiation rather than propagation, had the strongest correlation to fire severity in the areas we sampled... [W]e also found the more common stand descriptors of stand density and basal area to be important factors. But especially crucial are variables that determine tree resistance to fire damage, such as diameter and height. Thus, "fuel treatments" that reduce basal area or density from above (i.e., removal of the largest stems) will be ineffective within the context of wildfire management (22).

Omi and Martinson (2002) do not report information about fuel profiles that existed before the fires studied, and the spatial scale of events they considered confounds replication. However, the authors claim that management implications can be applied to other sites. A key implication is the importance of treating fuels "from below" in order to minimize likelihood of ignition and spread of crown fire. Keyes and O'Hara (2002:107) agree that raising stand-scale canopy base height by "pruning lower dead and live branches yields the most direct and effective impact" on crown ignition potential. They further note incompatibility of open forest conditions created by crown bulk density reduction treatments with conservation of threatened wildlife populations and prevention of rapid understory initiation and ladder fuel development, especially in the absence of an institutional commitment to stand maintenance treatments over time.

Perry and others (2004) investigated the relationship of forest structure and severe fire effects in ponderosa pine forest on the east face of the Cascade Range. Their data show, even where the historical fire regime is significantly altered by management, "a great deal of landscape heterogeneity in the degree of risk and the treatments required to lower risk" (Perry et al. 2004:923). Simulated treatments that reduced surface fuel load by 50 percent without any tree removal prevented torching behavior in 13 of 14 experimental plots, even with wind speeds exceeding 90^{th} percentile conditions; thinning from below (<12" dbh) coupled with surface fuel reduction prevented torching in the last plot (Perry et al. 2004). Those results agree with observations of the 2002 Hayman fire in Colorado, where crowning fire behavior ceased upon encountering large areas (several thousand acres) that had been treated with management-ignited prescribed fire (Graham 2003).

Other research demonstrates that removal of small-diameter trees in ponderosa pine forests affected by fire exclusion is more effective at reducing hazard of active crown fire than removal of larger trees (*e.g.*, Hunter et al. 2007, Arno and Fiedler 2005, Fiedler and Keegan 2002, Graham et al. 1999, Scott 1998). Forest Service research in New Mexico indicates no difference in short-term hazard comparing effects of "comprehensive" thinning in all size classes to treatments with a 16-inch upper diameter limit on tree removal (Fiedler and Keegan 2002).

Moreover, thinning with a 16-inch limit was more effective at reducing long-term fire hazard than treatments without a diameter cap (Fiedler and Keegan 2002).

The direction of fire spread relative to local topography (*e.g.*, backing, flanking, heading) is an important aspect of fire behavior and potential effects that should inform fuel management (Graham et al. 2004). Steep slopes can facilitate wind-driven convection currents that drive radiant heat upward and bring flames nearer to adjacent, unburned vegetation, thus pre-heating fuels and amplifying fire intensity as it moves upslope (Whelan 1995). As a result, severe fire effects may be relatively common at upper slope positions and on ridges, but less common on the lee side of slopes that do not receive frontal wind (Finney 2001).

Fuel treatments should be distributed with spatial patterns of fire spread in mind. Overlapping treatments that reduce horizontal fuel continuity can fragment severe fire effects into small patches if they disrupt heading fire potential and increase area burned by flanking fires as they move upslope (Finney 2001). Treatments on slope aspects facing away from frontal or diurnal winds are a lesser priority because backing fires are the most likely to exhibit mild intensity. The Forest Service should develop fire management standards and guidelines calling for analysis of spatial dimensions of local fire regimes and lay-out of fuel treatment actions that maximize the strategic impact on fire behavior and effects.

An additional approach to strategic location of treatments is to identify landscape features that are currently resilient to fire disturbance and use them to anchor landscape "compartments," or discrete fire management areas. This may include natural openings, meadows, relatively open ridges, moist riparian areas, mature forest patches with shaded and cool microclimates, and areas where fuel reduction work already has been completed. Such areas can facilitate appropriate fire management responses including confinement and containment as alternatives to control, as well as provide safe areas for workers to ignite prescribed fires for hazard reduction and ecological process restoration. Identification of such areas does not equate to actively treating them.

The Forest Service should prioritize active fuel management where relatively little resource investment may facilitate ecosystem fire resilience. This may include low-productivity sites where small tree encroachment is minimal (*e.g.*, dry southerly aspects) and relatively open stands dominated by large conifers. Targeting initial work in these areas will maximize the area to be treated with available funds and personnel, and thereby provide the greatest opportunity to quickly reduce fuels and restore ecosystem function at larger spatial scales.

Thanks for the chance to comment. Please contact with questions regarding any portion of this letter. Additionally, please send me a copy of the draft EIS when it is available. You may direct all communications and responses relating to this project directly to me.

Sincerely,

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Att.

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