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RE:Draft Environmental Impact Statement for the Coconino National Forest Land and Resource Management Plan Revision

This letter supplies comment from the Center for Biological Diversity ("Center") on the Draft Environmental Impact Statement ("DEIS") for proposed revision of the Coconino National Forest Land and Resource Management Plan. Notice of the DEIS published in the Federal Register on December 20, 2013, making this comment timely. See 78 Fed. Reg. 77121 (Dec. 20, 2013). The Center is a non-profit public interest organization with offices located in Flagstaff and Tucson, Arizona, representing more than 650,000 members and supporters nationwide dedicated to the conservation and recovery of species at-risk of extinction and their habitats. The Center has long-standing interest in management of the Coconino National Forest, and previously commented on this plan revision on December 10, 2010.1

Need for change

The EIS must clearly state and justify a need to change the existing forest plan (USDA 1987) as amended (USDA 1996), including reasons why current direction is inadequate to meet desired conditions, objectives and requirements of applicable laws and statutes. See 40 C.F.R. § 1502.13; also see 36 C.F.R. § 219 (1982). The draft plan identifies numerous changes in forest conditions since the adoption of the 1987 Coconino Forest Plan, including drift from presumed reference conditions and need for updated consideration of plant and animal species that are at- risk of extinction. The Center identified in its December 10, 2010, scoping comment other conditions meriting response and consideration in the draft plan including, but not limited to, consequences of climate change, increased public use of forest resources, reduced water availability and degradation of species habitat due to past forest uses. The "need for change" outlined in the DEIS does not sufficiently articulate reasons for abandoning decisions and components (i.e., standards and guidelines) of the existing Coconino Forest Plan.

1 This letter incorporates by reference the December 10, 2010, comment of the Center responding to the notice of intent to prepare this DEIS. See 75 Fed. Reg. 26711-14 (May 12, 2010).

Timber suitability

Under the National Forest Management Act ("NFMA," 16 U.S.C. §§ 1600-1687), forest management plans must assure suitability of lands where timber production is allowed. 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). Forest Service responsibility 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 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 applicable regulations state that timber suitability designations in forest plans must apply cost-benefit analysis and "stratify" lands by allowable intensity of timber management:

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) (1982). Historically, the Forest Service has met this requirement by dividing the Coconino National Forest into discrete land use zones, or "management areas," each of which set forth standards and guidelines governing site-specific multiple use activities (USDA

1987). 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). The agency also historically engaged in cost-benefit analysis of stratified timber management strategies to assure the largest excess of discounted benefits less discounted costs (USDA 1987a, 1987b).

In addition to determining suitability for timber production on portions of the national forest, the Forest Service also must review its prior classification of lands as unsuitable for timber production. See 16 U.S.C. § 1604(k); 36 C.F.R. § 219.14(b) (1982). It is not sufficient under NFMA to list the lands that previously were deemed unsuitable and carry forward that designation into a revised forest plan. Further analysis and comparison of alternatives is required. To inform analysis of timber suitability, we ask the Forest Service to consider and analyze the following criteria for designating lands as unsuitable for timber production:

*High or severe soil erosion hazard identified by Terrestrial Ecosystem Survey.
*Slopes steeper than 20 percent.
*Lands within one site-potential tree height of perennial or intermittent streams or wetlands (e.g., generally 100-

150 feet on either side of a stream bank in conifer forest vegetation types).
*Contiguous areas larger than 1,000 acres without roads in all vegetation types.
*Occupied and/or critical habitat of threatened or endangered species or candidate species proposed for listing.
*Designated conservation areas for sensitive or management indicator species.
*Occupied locations of endemic species with ranges limited to the national forest.
*Lands impacted by high-severity fire effects to vegetation or soil.

Regarding the last criterion above, logging and planting trees on sites impacted by wildland fire poses a different benefit-to-cost analysis from management of unburned forests. Long-term losses of soil productivity resulting from synergistic impacts of fire and mechanical disturbances (e.g., "salvage logging"), particularly where spread of exotic invasive species is a management concern, must be considered and analyzed in the timber suitability determination (Perry et al.
1989, Perry et al. 1995, McIver and Starr 2000, Beschta et al. 2004, Lindenmayer et al. 2004, Donato et al. 2006, Lindenmayer et al. 2008). Even with landscape-scale fuel management intended to reduce the probability and extent of high-severity fire effects to vegetation and soil, as proposed to varying degrees of intensity in all alternatives, severe fire effects on suitable timberlands are reasonably foreseeable (Swetnam and Betancourt 1998, Grassino-Mayer and Swetnam 2000, Gedalof et al. 2005, Running 2006, Westerling et al. 2006, Littell et al. 2009).
Therefore, the Center proposes adding a caveat to the timber suitability designation in the revised forest plan stating that forest lands affected by severe fire effects to vegetation or soil will be managed for natural recovery rather than for economic production.

Grazing suitability

NFMA implementing regulations require the Forest Service to determine "the suitability and potential capability of National Forest System lands for producing forage for grazing animals and for providing habitat for management indicator species." 36 C.F.R. § 219.20

(1982). "The present and potential supply of forage for livestock, wild and free-roaming horses and burros, and the capability of these lands to produce suitable food and cover selected wildlife species shall be estimated." Id. § 219.20(a). Where the agency identifies lands that are "in less than satisfactory condition," it "shall" plan for their restoration. Id. The agency must consider, among other things, "possible conflict or beneficial interactions among livestock, wild free- roaming horses and burros and wild animal populations, and […] direction for rehabilitation of ranges in unsatisfactory condition…" Id. § 219.20(b).

Ecological costs of livestock grazing exceed those of any other use of national forest lands in the American Southwest. In this arid region subject to chronic and intensifying drought (Seager et al. 2007, Seager and Vecchi 2010, Williams et al. 2012), livestock grazing is the most widespread cause of species endangerment, lost soil productivity, and degradation of the human environment (Beschta et al. 2012, Fleischner 1994). Grazing destroys vegetation, displaces soil, and consumes enormous quantities of water to the detriment of native species and the ecosystems on which they depend (Belsky et al. 1999, Belsky and Blumenthal 1997).

Range capability in the Coconino National Forest significantly changed since the mid-
1980s, when grazing suitability assumptions on which the draft plan is based were developed. Prior estimates of range capability did not account for synergistic effects of livestock grazing and climate change on soil, water, vegetation and fire regime (Beschta et al. 2012). It is unlikely that range resources in the planning area ever will return to "historical norms" that supported forage production capacity over the past century:

Despite ample uncertainties in model projections of hydroclimate change, and the continuation of natural climate variability on all timescales, it seems very probable that [South Western North America - "SWNA"] will be drier in the current century than in the one just past. Skillful prediction of the magnitude and timing of this drying will

require prediction of the rate of anthropogenic change and prediction of the evolving natural variability for which currently there is scant evidence of any predictability beyond the interannual timescale. Another likely outcome is a continuing decline in winter snowpack and earlier onset of snow melt that will add to the stress on regional water resources.

Seager and Vecchi (2010: 21282). Historically, "interglacial climates in the southwestern US can experience prolonged periods of aridity, lasting centuries to millennia, with profound effects on water availability and ecosystem composition. The risk of prolonged aridity is likely to be heightened by anthropogenic forcing" (Fawcett et al. 2011: 520). Williams and others (2012) noted that while average winter precipitation totals in the Southwest have not been exceptionally low in the recent past, average summer-fall evaporative demand since 2000 is the highest in the past 1,000 years. Forest drought stress over much of the past 13 years, including in 2011 and
2012, matched or exceeded the recorded "megadroughts" of the 13th and 16th centuries. The only other 13-year periods when similar conditions occurred with such frequencies in the past 1,000 years were during the megadroughts themselves. The strongest megadrought occurred during
the second half of the 1200s and is believed to have played an important role in the abandonment of ancient Puebloan cultural centers throughout the Southwest. The observed trends in drought stress on forest conditions coincide with strong climate model agreement on anthropogenic

greenhouse warming. Model projections indicate that megadrought-level stresses on water availability and vegetation production will be regularly exceeded by the mid-21st century, and even the wettest and coolest years of the late-21st century will be more severe than the driest, warmest years of the past millennium (Williams et al. 2012). The Forest Service does not account for this information, which has been repeatedly supplied to it through numerous public comments on allotment-specific management plans in the Coconino National Forest. See DEIS at 933-937 (grazing suitability determination does not take hard look at effects of climate change on forage productivity, but defers to a Terrestrial Ecosystem Survey presuming climate to be static, and largely mirrors the 1987 plan decision, plus or minus 6 percent of total forest acreage).

Drought will continue to impact range capacity and utilization levels for the duration of the revised forest plan (Fawcett et al. 2011, Seager et al. 2007, Seager and Vecchi 2010), and it is likely to transform resource availability by stressing water supplies and net productivity, which
in turn will produce novel environments (Williams et al. 2012). The Forest Service should disclose the foreseeable range of climate effects to range suitability, and candidly disclose past instances when livestock grazing has exceeded capability. The Forest Service is required by NEPA to take a hard look at potentially significant impacts at direct, indirect and cumulative effects of the draft plan to grazing suitability. The methods used to determine suitability must be clearly described in a way that is understandable to the decision-maker and the general public.

Despite its environmental costs, the Forest Service continues to promote livestock grazing with $100 million annually in direct subsidy to private ranching interests for "range improvements." This includes spring and well development; installation and replacement of water tanks and pipelines, fence construction and repair, road reconstruction and repair, and vegetation treatments, particularly in areas where woody tree species now encroach on historical grasslands. The analysis should take a hard look at effects of foreseeable range "improvements" to the environment, propose standards and guidelines to limit their impact, quantify the financial cost to taxpayers that may result, and specify any source of appropriated funds that the Forest Service intends to use to pay for them.

The Forest Service charges livestock grazing permit holders only $1.35 in fees per animal unit month ("AUM").2 In contrast, the average monthly lease rate in 2011 for livestock grazing on private lands in 11 western states surveyed by the Congressional Research Service was
$16.80 per head, more than 12 times greater an amount per AUM than the Forest Service charges permit

holders to graze national forest lands.

BLM and the FS typically spend far more managing their grazing programs than they collect in grazing fees. For example, the GAO determined that in FY2004, the agencies spent about $132.5 million on grazing management, comprised of
$58.3 million for the BLM and $74.2 million for the FS. These figures include expenditures for direct costs, such as managing permits, as well as indirect costs, such as personnel. The agencies collected $17.5 million, comprised of $11.8 million in BLM receipts and $5.7 million in FS receipts.

2 An AUM is the occupancy and use of public lands by one cow and her calf, one horse, or five sheep or goats for a month.

For FY2009, BLM has estimated appropriations for grazing management at $49.3 million, while receipts were $11.9 million. The FS has estimated FY2009 appropriations for grazing management at $72.1 million, with receipts estimated
at $5.2 million. Receipts for both agencies have been relatively low in recent years, apparently because western drought has contributed to reduced livestock grazing and the grazing fee was set at the minimum level for 2007-2011.

Other estimates of the cost of livestock grazing on federal lands are much higher. For instance, a 2002 study by the Center for Biological Diversity estimated the federal cost of an array of BLM, FS, and other agency programs that benefit grazing or compensate for impacts of grazing at roughly $500 million annually.3

The Forest Service charges grazing permit holders an unreasonably low fee to run livestock on national forest lands. As a result, it returns less than 10 percent of its expenditure of public funds for grazing management to the U.S. Treasury. Federal subsidies shield the grazing permit holder from paying market rates for services it acquires on public lands free of charge. The agency should make this clear in its benefit-cost analysis of the revised forest plan.

Aspen stands are declining within the Coconino. Livestock grazing suppresses aspen regeneration (Sampson 1919, Houston 1954, Kay 2001, Beschta and Ripple 2010). To protect declining aspen stands, livestock, areas that contain aspen stands should be excluded from livestock grazing and classified as unsuitable for this activity. As discussed previously, riparian and wetland areas should also be classified as unsuitable for grazing except in instances where valid existing water rights require access to these areas.

One way the Forest Service can achieve better management of land resources is by allowing current grazing permit holders to voluntarily retire their allotments for conservation purposes. This will build flexibility into Forest management and allow for improved habitat and protection of understory seed banks in an uncertain climatic future.

Finally, The Forest Service is required by NEPA and the NFMA to consider and disclose potentially significant direct, indirect and cumulative effects of the Draft Plan and considered alternatives on wildlife viability, as well as uncertainty and controversy. The Supplemental Aquatic Species Report for the DEIS identifies grazing as a potential threat to aquatic and
riparian species. It states both that "[e]xcessive or poorly timed ungulate grazing in riparian areas can reduce plant and animal diversity and negatively affect riparian habitat and those species that depend on it for their survival," (USDA 2013: 5, and that "[l]ivestock grazing can contribute to increased sedimentation into aquatic systems and thus affect TES aquatic species, planning species, and macroinvertebrates, " (USDA 2013: 8). However, there is not a comprehensive analysis of the direct or indirect of the proposed grazing management

strategies, desired conditions, or standards or guidelines on any of the identified riparian and aquatic species. See DEIS at 333-405. References to the effects of sedimentation and soil disturbance to these species are only presented in the context of potential effects from recreational uses. Id. Nor does the

3 C.H. Vincent. 2012. Grazing Fees: Overview and Issues. Congressional Research Service: Washington, D.C. June 19. 11 pp. Attached for convenience.

analysis in the DEIS of environmental impacts of the management of livestock grazing discuss impacts on any species. See DEIS at 704-692. The Forest Service needs to identify and discuss the impacts on species viability and habitat from the livestock grazing desired conditions, standards, guidelines and suitability determination.

Species viability

The NFMA directs the Secretary of Agriculture to issue regulations "that set out the process for the development and revision of the land management plans, and the guidelines and standards prescribed by this subsection." 16 U.S.C. § 1604(g). The Secretary "shall … incorporate the standards and guidelines required by this section in plans for units of the National Forest System…" Id. § 1604(c). The NFMA further requires standards for timber and transportation management as well as for public participation in forest plans. See id. §§§ 1604(m); 1608(c); 1612(a).

Further, regulations implementing the 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) (1982). Forest plans must establish "standards and requirements by which planning and management activities will be monitored and evaluated." Id. § 219.5(a)(7) (1982). Standards and guidelines must be "qualitative and quantitative." Id. at § 219.1(b)(12) (1982). Additionally, forest plans must define reasons for management practices chosen for each vegetation type and circumstance. See id. § 219.15 (1982).

The NFMA implementing regulations also require, "Fish and wildlife habitat shall be managed to maintain viable populations of existing native and desired non-native vertebrate species in the planning area." 36 C.F.R. § 219.19 (1982). "For planning purposes, a viable population shall be regarded as one which has the estimated numbers and distribution of reproductive individuals to insure its continued existence is well distributed in the planning area. In order to insure that viable populations will be maintained, habitat must be provided to support, at least, a minimum number of reproductive individuals and that habitat must be well distributed so that those individuals can interact with others in the planning area." Id. In addition, the
Forest Service is required to identify and plan for management indicator species ("MIS"):

In the selection of management indicator species, the following categories shall be represented where appropriate: Endangered and threatened plant and animal species identified on State and Federal lists for the planning area; species with special habitat needs that may be influenced significantly by planned management programs; species commonly hunted, fished, or trapped; non-game species of special interest; and additional plant or animal species selected because population changes are believed to indicate the effects of management activities on other species of selected major biological communities or on water quality. On the basis of available scientific information, the interdisciplinary team shall estimate the effects of changes in vegetation type, timber age classes, community composition, rotation age, and year-long suitability of habitat related

to mobility of management indicator species. Where appropriate, measures to mitigate adverse effects shall be prescribed.

Id. § 219.19(a)(1) (1982). "Planning alternatives shall be stated and evaluated in terms of both amount and

quality of habitat and of animal population trends of the management indicator species." Id. § 219.19(a)(2) (1982). "Population trends of the management indicator species will be monitored and relationships to habitat changes determined. This monitoring will be done in cooperation with State fish and wildlife agencies, to the extent practicable." Id. § 219.19(a)(6) (1982). "Habitat determined to be critical for threatened and endangered species shall be identified, and measures shall be prescribed to prevent the destruction or adverse modification of such habitat." Id. § 219.19(a)(7) (1982).

The draft plan proposes to significantly roll back standards and guidelines in the current Forest Plan (USDA 1987), as amended (USDA 1996), that constrain management of the Coconino National Forest and ensure species viability. It does not meet the statutory and regulatory requirements discussed above. The Forest Service is not writing the plan on a blank slate, but rather it is significantly revising and weakening the existing Forest Plan, which has been in effect for many years. "[A]n agency changing its course must supply a reasoned analysis." Motor Vehicles Manufacturers Assoc. v. State Farm, 463 U.S. 29, 57 (1983). The Forest Service must consider the effect of the existing Forest Plan on all NFMA mandates (e.g., species viability), explain why it is changing course by deleting or weakening standards and guidelines, and disclose how those changes will impact the environment.

Standards and guidelines in the current Coconino Forest Plan (USDA 1987), as amended, are designed to ensure viability of federally listed and regionally sensitive wildlife populations, as well as continued function of ecological processes associated with old growth forests (USDA 1996). In contrast, the draft plan would repeal virtually all existing standards and guidelines and replace them with vaguely worded "desired conditions" and "objectives," which appear designed to maximize agency discretion and evade public accountability in project-level decision-making affecting management of national forest lands. The Forest Service offers no explanation for the change of course described in the action alternatives (B, C and D).

The revised forest plan must apply the species viability requirement as a starting point to develop mandatory protections for fish and wildlife populations on the national forest. To be useful and meaningful, the analysis of the environmental consequences of alternatives should explicitly apply the viability requirement, specify a minimum number of reproductive individuals for each species of planning concern, and demonstrate that the spatial distribution of habitat is adequate to maintain populations. Where the draft plan proposes a different management approach to species viability than the current Forest Plan (USDA 1987), as amended, the agency must provide a reasoned explanation for the change of course and compare impacts to the environment.

The draft plan does not propose adequate direction to ensure that management will meet the species viability requirement of the NFMA. In this plan revision, the Forest Service relies upon "desired conditions" to accomplish the need for change. See DEIS at 5 ("Desired conditions, goals, and objectives express an aspiration and form the basis for projects, activities,

and uses that occur under the forest plan"); also see Draft Plan at 5 ("Desired conditions are the focus of this plan; management of the Coconino NF's resources will be directed toward achieving the desired conditions. Desired conditions are the basis for the other plan components and describe the framework for future projects and activities"). It defines desired conditions as:

Desired conditions (or goals) set forth the desired social, economic, and ecological goals of the Coconino NF. They attempt to paint a picture of what we (the public and the Forest Service) desire the forest to look like or the goods and services we desire it to provide. Desired conditions are generally expressed in broad, general terms; however, more specificity may be added to clarify the intent. Desired conditions are timeless in that there is no specific date by which they are to be completed. They may only be achievable over a long timeframe (e.g., several hundred years).

Draft Plan at 5.4 In site-specific actions, "management activities affecting the Coconino NF must be consistent with the plan." Id. 9. Consistency with plan direction is to be achieved as such:

Management activities are developed specifically to achieve the desired conditions (goals) of the plan. To the extent practicable, documentation for such projects should identify the elements of the desired conditions to be achieved by the project. All projects or activities may not contribute to all desired conditions or objectives but rather to a limited subset. Also, some projects designed to contribute to some desired conditions may have consequences considered adverse to the achievement of other desired conditions. In this situation, the responsible official for the project needs to identify and disclose these effects in the project documentation and make a decision that balances these considerations.

Id. 9 [emph. added]. The Draft Plan contemplates that management actions will sometimes conflict with the desired conditions. It further assumes that many of the desired conditions will not be realized during the life of the revised plan. Therefore, desired conditions are not enforceable and would not affect project-level forest management.

Similarly, the Forest Service defines plan "objectives" in a way that does not carry any force or effect on decision-making in site-specific management actions.5 See Draft Plan at 5 ("Activities specified in objectives are intended to help make progress toward achieving desired conditions and represent just some of the outcomes or actions expected to accomplish movement

4 NFMA implementing regulations applicable to this plan revision define a "goal" as, "A concise statement that describes a desired condition to be achieved sometime in the future. It is normally expressed in broad, general terms and is timeless in that it has no specific date by which it is to be completed. Goal statements form the principal basis from which objectives are developed." 36 C.F.R. § 219.3 (1982).

5 The NFMA implementing regulations applicable to this plan revision define "objective" as, "A concise, time-specific statement of measurable planned results that respond to pre-established goals. An objective forms the basis for further planning to define the precise steps to be taken and the resources to be used in achieving identified goals." 36 C.F.R. § 219.3 (1982).

toward desired conditions. Not every action or objective the Coconino NF may do is identified in the plan, just the primary ones").

Only suitability determinations, standards and guidelines actually constrain project-level decisions. See id. 5-6; 9 ("Projects are expected to comply with suitability, standards, and guidelines contained in the plan"); also see DEIS at 5 ("Suitability determinations, standards, and guidelines set requirements to limit or guide forest uses or activities that are expected to occur under the forest plan"). However, there is a significant distinction between those plan components. A standard is an "absolute requirement" to be met in the design of projects and activities, whereas a guideline is a "sideboard" from which deviation "is permitted without a plan amendment, as long as the intent of a guideline is met." Draft Plan at 5-6. The Forest Service clearly anticipates in the Draft Plan instances when project-level decisions will deviate from proposed guidelines without a plan amendment.

Clear and binding standards and guidelines are essential to the continued viability of many endangered, threatened and sensitive species whose viability is in doubt. However, the draft plan largely proposes to address threats to the viability of threatened, endangered and/or sensitive species through components other than standards and guidelines. Where it proposes guidelines, the draft plan merely suggests that forest managers

"should" consider them in project-level decisions. See, e.g., draft plan at 74 ("Habitat management objectives and species protection measures from approved recovery plans should be applied to activities occurring within federally listed species habitat to promote recovery of the species") [emph. supplied].

Other than "standards for all vegetation types," which only assert statutory requirements of the NFMA regarding timber management (Draft Plan at 34), the draft plan proposes only five standards that are relevant to viability of threatened, endangered and/or sensitive species in the Coconino National Forest:

*"FW-BioPhys-Geo-S: For caves that have been designated or nominated as 'significant,' manage to perpetuate those features, characteristics, values, or opportunities for which they were designated." Draft plan at 29.
*"FW-Veg-Grass-SDG-S: Recreation goals are subordinate to antelope protection." Id.
45.

*"FW-Veg-AT-S: Recreation activities, including new route construction, shall avoid important habitat for the San Francisco Peaks ragwort and result in minimal disturbance to its habitat." Id. 71.

*"FW-WFP-S: Direction for species listed as threatened, endangered, proposed, or candidate takes precedence over direction for species not listed by the U.S. Fish and Wildlife Service." Id. 74.

*"FW-Graz-S: Water developments shall incorporate escape devices to prevent animal entrapments." Id. 79.

Notably, the draft plan does not propose any binding standards for management activities that may affect federally endangered, threatened or candidate species known to exist in the Coconino National Forest. None of the standards listed above will singularly or cumulatively ensure the conservation or recovery of species that are at-risk of extinction, as evidenced by listing under the federal Endangered Species Act ("ESA," 16 U.S.C. §§ 1531-1544), or guarantee viability of
vertebrate species, as required by the NFMA. It would effectively repeal existing protections for at-risk plants and wildlife with no assurance of viability or recovery.

Reliance on discretionary planning guidelines in lieu of binding standards is a controversial means of providing for species viability because only the Forest Service can interpret the "intent" of guidelines. The Forest Service is "entitled to deference to their interpretation of their own regulations, including Forest Plans." Hapner v. Tidwell, 621 F.3d
1239, 1251 (9th Cir. 2010) (internal quotation omitted). All proposed guidelines contain the discretionary word "should," not mandatory terms such as "will" or "shall." See U.S. v. UPS Customhouse Brokerage, Inc., 575 F.3d 1376, 1382 (Fed. Cir. 2009) ("'Will' is a mandatory term, not a discretionary one."); New England Tank Indus. of N.H., Inc. v. United States, 861
F.2d 685, 694 (Fed. Cir. 1988) (noting difference between mandatory term "will" and discretionary term "should"). The Ninth Circuit recognized that forest plan guidelines are not equivalent to mandatory standards, and held that forest plan language stating that old growth forest stands "should" be at least 25 acres in size was "a guide for planning purposes, but does not prohibit counting stands less than 25-acres as old growth." Lands Council v. McNair (537
F.3d 981 (9th Cir. 2010 en banc). More, in Ecology Center v. Castaneda, 574 F.3d 652, 660-61 (9th Cir. 2009), the Ninth Circuit held that the language of guidelines incorporated into a forest plan did not "create a mandatory standard." The guidelines were not enforceable under NFMA because they were cast in "suggestive" language using the word "should," and "merely recommended" a particular practice "when possible." Id. at 661 (internal quotation omitted).

Forest Service reliance on aspiration statements of desired conditions and objectives, even coupled with semi-

accountable guidelines, in lieu of enforceable standards that constrain project-level decisions and site-specific management, fails to meet NFMA requirements. See, e.g., Citizens for Better Forestry v. U.S. Department of Agriculture, 632 F.Supp.2d 980-81 (N.D.Cal., 2009). The draft plan 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). Reducing or repealing environmental standards in a forest plan will result in lesser or no environmental standards at the site-specific level. Id. at 975. The absence of enforceable standards in the draft plan affecting management of wildlife habitat contradicts NFMA and its planning regulations.6 See 16 U.S.C. §§ 1604(c) and (g); 36 C.F.R. §§§§ 219.1(b), 219.11(c),
219.12(f)(9)(iii) and 219.15 (1982).

Example: Mexican spotted owl

Mexican spotted owl ("MSO") is listed under ESA as "threatened" with critical recovery

6 The scope, placement, duration and intensity of most foreseeable management activities on national forest lands, including road construction and timber harvest, would be subject to the unlimited discretion of the Forest Service.

habitat in the Coconino National Forest. It is proposed as a management indicator species ("MIS") in the draft plan. There can be no reasonable assurance that the draft plan will assure MSO viability or recovery where the Forest Service admits uncertainty regarding owl habitat and population trends and simultaneously admits that implementation of the revised plan may "adversely affect" the species and/or result in incidental take (USDI 2012b, 2005).

In October 2008, the Southwestern Regional Office of the Forest Service produced an "Annual Report" to the U.S. Fish and Wildlife Service ("FWS") regarding implementation of forest management plans, including the Coconino Forest Plan, and effects to MSO and other ESA-listed species, for the period of June 10, 2005, through June 10, 2007.7 In it, the Forest Service acknowledged failure to comply with mandatory terms and conditions established in the June 10, 2005, biological opinion and incidental take statement of the FWS that required monitoring of MSO populations and habitat trends (USDI 2005). The Forest Service admitted that it monitored only 20-to-25 percent (20-25%) of known Protected Activity Centers ("PAC") for owl occupancy, and it monitored no PAC for owl reproduction or juvenile dispersal. In addition, the Forest Service stated that it "likely" exceeded the permitted number of incidental take of MSO. On April 17, 2009, the Forest Service asked the FWS to reinitiate consultation regarding continued implementation of forest plans in the Southwestern Region, including the Coconino Forest Plan, as required by the ESA. That letter stated, "It has now become apparent that the Forest Service will likely soon exceed the amount of take issued for at least one species,
the Mexican spotted owl."8 More, "[I]t has become apparent that the Forest Service is unable to fully implement and comply with the monitoring requirements associated with the Reasonable and Prudent Measures for several species (including MSO) in the [biological opinion]."

On June 22, 2010, the FWS reinitiated consultation with the Forest Service regarding effects of continued implementation of forest plans, including the Coconino Forest Plan, on
ESA-listed species.9 Pursuant to that consultation, on March 30, 2012, the FWS produced a new biological opinion and incidental take statement for MSO that is specific to the Coconino National Forest. That opinion and statement (USDI 2012b) eliminated mandatory terms and conditions that previously required the Forest Service to monitor MSO habitat and populations, and replaced them with a more modest requirement to report incidental take (i.e., PAC disturbance). The FWS broke precedent and fragmented its consultation on MSO by issuing a separate biological opinion and incidental take statement for each national forest, including the Coconino National Forest. None of the forest-specific biological opinions on implementation of forest plans in the Southwestern Region account for range-wide impacts to MSO and critical habitat, and none require monitoring of

population or habitat trends, which remain unknown. Forest Service compliance with terms and conditions of the March 30, 2012 biological opinion

7 USDA Forest Service. 2008. Annual Report Covering the Period June 10, 2005 - June 10, 2007, Programmatic Biological Opinion on the Land and Resource Management Plans for the 11 National Forests in the USDA Forest Service Southwestern Region. Albuquerque, NM. October. 110 pages.

8 Corbin Newman, Southwestern Regional Forester, letter to Benjamin Tuggle, Director, FWS Southwestern Region, requesting re-initiation of Consultation #2-22-03-F-366. April 17, 2009. 2 pages.

9 U.S. Fish and Wildlife Service letter, to Corbin Newman, Regional Forester, USDA Forest Service re: Cons. # 2-22-03-F-366, June 22, 2010. Region 2: Albuquerque, NM. 3 pages.

and incidental take statement for the Coconino National Forest, and any similar incidental take statement issued for this plan revision, will not avoid jeopardy to MSO or adverse modification of critical habitat because the conservation status of the threatened species and the effect of habitat management throughout its range is unknown.

Recovery plans for federally listed species (e.g., USDI 2012a) are not enforceable in project-level management decisions. Referencing them in discretionary guidelines of a revised forest plan fails to ensure viability or avoid jeopardy or destruction or adverse modification of critical habitat. See USDI (1996a: 39) (MSO jeopardized and critical habitat adversely modified where forest plans "lack the management direction to prevent the development of forest project- level activities that are likely to adversely affect the Mexican spotted owl," and stating, "[S]tandards and guidelines are, 'the bounds or constraints within which all management activities are to be carried out in achieving forest plan objectives.'"); also see USDI (1996b: 29) (concluding no-jeopardy to MSO and no adverse modification of critical habitat because the Forest Service applied recovery plan recommendations as non-discretionary standards and guidelines in forest plans).

The viability analysis of MSO also is flawed because the Forest Service has failed to explain and candidly disclose impacts of its proposed reversal of standards and guidelines in the current Forest Plan (USDA 1987), as amended (USDA 1996), that constrain modification of critical habitat. See 36 C.F.R. § 219.19(a)(7) (1982) ("Habitat determined to be critical for threatened and endangered species shall be identified, and measures shall be prescribed to prevent the destruction or adverse modification of such habitat"). The only proposed measure that may prevent destruction or adverse modification of critical habitat is discretionary.

The draft plan omits current (USDA 1996) standards and guidelines that (1) require survey of suitable MSO habitat for presence of the bird and designation of PAC where it occurs; (2) forbid vegetation treatments in nest cores and allow limited treatments in PAC; (3) require selection of an equal number of PAC as untreated control areas when treatments are done; (4) prohibit harvest of trees larger than 9-inches diameter in PAC; (5) maintain a portion of "target/threshold" habitat suitable for nesting/roosting behaviors and retain at least 150-170 ft^2/acre basal area and 20 trees/acre larger than 18-inches diameter at breast height; (6) retain trees larger than 24-inches diameter at breast height in suitable nesting/roosting habitat (i.e., "restricted areas"); and (7) require monitoring of habitat and population trends. See USDA (1996: 87-91).

Repeal of standards and guidelines affecting MSO can be viewed as a negative effect of the draft plan, which will result in an actual physical effect on the environment. See Citizens for Better Forestry v. U.S. Dept. of Agriculture, 341 F.3d 961, 973 (9th Cir. 2003). Weakening standards in a forest plan may significantly impact the environment at a site-specific level. Id. at
975; also see Motor Vehicles Manufacturers Assoc. v. State Farm, 463 U.S. 29, 57 (1983) ("[A]n agency changing its course must supply a reasoned analysis"). The Forest Service must disclose effects of the existing

Forest Plan (USDA 1987), as amended (USDA 1996), on MSO viability and recovery, and explain why it is changing course by repealing or weakening current standards and guidelines. The efficacy of proposed management direction in promoting the conservation and recovery of MSO is uncertain (USDI 1995, USDI 2012a). The Forest Service is required by

NEPA to disclose controversy and uncertainty regarding effects to MSO and its critical habitat.

The Forest Service should study, develop and describe an action alternative that gives the decision-maker and the public a meaningful basis for comparison of impacts that may result from the revised forest plan to MSO and its critical habitat. At minimum, such an alternative should, consistent with the best available science:

* Implement existing standards and guidelines for MSO habitat (USDA 1996).

* Limit new road construction in PAC (USDI 2012a).

* Apply fuel treatment concepts to minimize risk of stand-replacing fire in PAC, including large tree retention, management of surface fuels and sub-canopy forest structure, and spatial orientation of treatments, as described infra.

* Emphasize spatial orientation of fuel treatments in MSO habitat consistent with findings and recommendations of Northern Arizona University Forest Ecosystem Restoration Analysis (Prather et al. 2008).

Prather and others (2008) is relevant to this analysis because it is: (1) specific to dry mixed conifer, wet mixed conifer and ponderosa pine vegetation types that comprise MSO critical habitat in the planning area; (2) consistent with the need for change; (3) representative of best available science; and (4) offers a meaningful basis for comparison of the intensity of environmental impacts that may result from this plan revision. "[E]ven without application of treatments that would seriously affect MSO habitat, managers could achieve approximately 60% of the fuels reduction that would be achieved if there were no restrictions on treatments. With reasonable tradeoffs considered in planning, such as largely treating in lower suitability owl habitat, this figure would rise to over 80%" (Prather et al. 2008: 148). "When conservation and restoration planning is scaled-up from a stand to landscape scale, many apparent conflicts disappear as management actions are spatially partitioned and prioritized" (Prather et al. 2008:
149).

Example: northern goshawk

The draft plan proposes to repeal or weaken standards and guidelines of the current Forest Plan (USDA 1987), as amended (USDA 1996), that bind project-level management of habitat for sensitive northern goshawk. Specifically, it omits standards and guidelines for management of ponderosa pine forest structure contributing to nesting, fledging and foraging habitat. The current Forest Plan incorporates the Management Recommendations for the Northern Goshawk in the Southwestern United States (Reynolds et al. 1992), which quantifies structural attributes of habitat essential to viability of northern goshawk and 14 vertebrate prey species. The Forest Service previously based action alternatives in two prior environmental impact statements about forest planning on those recommendations (USDA 1995, 2006). It further established a habitat-proxy relation of ponderosa pine forest structure to viability of northern goshawk, and a proxy-on-proxy relation of goshawk habitat to viability of 14 prey species, which courts have deemed legally sufficient.

In contrast, the draft plan proposes only desired conditions and objectives to replace existing standards and guidelines that assure viability of goshawk and its prey. The draft plan components are nearly identical to those proposed by other national forests in Arizona, except that they are even more discretionary than proposed by

other national forests, indicating a regionally-orchestrated agenda to evade public accountability at the expense of species viability. The draft plan proposes no binding standards or discretionary guidelines for management of northern goshawk habitat. Notably, it omits any requirement to survey for goshawks prior to habitat disturbance, monitor populations or retain structural attributes of ponderosa pine forest (e.g., canopy cover) essential to nesting and fledging behaviors of the sensitive species, in contrast to the existing Forest Plan, as amended (USDA 1996).

In addition, the draft plan proposes "fine scale" desired conditions (less than 10 acres) for ponderosa pine forest that include retention of trees within groups typically less than 1 acre each consisting of approximately 2 to 40 trees with interlocking canopies. The Arizona Game and
Fish Department expressed concern to the Forest Service that management of uneven-aged ponderosa pine forest structure, including canopy cover, at small tree "group" scales instead of at larger (10-40 acre) stand scales has the potential to significantly reduce the amount of forest
cover with potentially negative consequences for goshawk and its prey.10 For example, assuming a residual canopy cover of 50 percent within tree groups (<1 acre), and if such groups occupy 50 percent of a stand, canopy cover at the stand scale will be 25 percent or less. To prevent this outcome, which clearly would harm goshawk and its prey, Reynolds and others (1992) recommended, and the amended Forest Plan (USDA 1996) requires, maintenance of canopy cover canopy cover in mid- to old-aged stands that host goshawk nesting and fledging habitat. The Forest Service is required by NFMA and NEPA to address changes in management direction affecting northern goshawk habitat and potential effects to the environment.

Habitat proxy

The Forest Service proposes in the draft plan to meet its obligation under NFMA to ensure species viability by managing habitat at broad scales, i.e., by moving toward desired conditions for each potential natural vegetation type ("PNVT") in the Coconino National Forest. It applies a novel screening process for groups of species associated with each PNVT, and avoids focused analysis of minimum viable populations or habitat distribution of any particular species. The draft plan considers only the overall amount of habitat, defined as acres within each PNVT and their relative degree of departure from an historic range of variability ("HRV"), as a

10 See notes of Arizona Game and Fish Department Region II Commission Briefing, July 27, 2007. In it, the Department explains, "the Management Recommendations for the Northern Goshawk in the Southwestern United States (GTR-RM-217) defines northern goshawk habitat through the structural habitat attributes of 14 of the hawk's prey species. The canopy cover data described for these prey species, and for the northern goshawk, were measured at the stand level - not the tree group level. By changing the canopy cover targets from the stand level to the group level, the Department is concerned that the Forest Service may not be meeting the habitat requirements for those 14 wildlife species, and also may not be meeting the habitat requirements for the northern goshawk per the 1996 Forest Plan Amendment."

surrogate for analysis of populations of sensitive species whose viability is of planning concern. By assuming full occupancy of at-risk species in each PNVT, the Forest Service overestimates the effectiveness of its habitat-based proxy for maintaining viability. The agency recognizes that it is has little or no information about sensitive species populations. Not all acres of each PNVT are likely to be occupied by species whose actual distribution and habitat use is likely to be more limiting than assumed by the analysis.

Use of habitat as a proxy to ensure viability of sensitive species is permissible only when both the agency's "knowledge of what quality and quantity of habitat is necessary to support the species," and its "method for measuring the existing amount of that habitat" are reliable and accurate. Oregon Natural Resources Council Fund v. Goodman, 505 F.3d 884, 890 (9th Cir.
2007); see also Earth Island Inst. v. U.S. Forest Serv., 442 F.3d 1147, 1175-76 (9th Cir. 2006); Gifford Pinchot

Task Force v. U.S. Fish and Wildlife Serv., 378 F.3d 1059, 1066 (9th Cir. 2004) ("The test for whether the habitat proxy is permissible … is whether it reasonably ensures that the proxy results mirror reality."). The DEIS does not demonstrate that the draft plan will meet legal standards for a reliable and accurate habitat-proxy analysis of species viability. This shortcoming renders Forest Service conclusions about species viability arbitrary and capricious.

Furthermore, as vegetation communities change in composition and shift in space over the life of the revised forest plan (Allan and Sodden 2008, Grassino-Mayer and Swetnam 2000, Jones et al. 2009, Millar et al. 2007, Seager and Vecchi 2010, Skinner 2007, van Mantgem and Stephenson 2007, Williams et al. 2012), plant community succession and individual plant growth dynamics also will change. This fact presents a significant challenge for adaptive management because detection of change and adaptation requires robust monitoring systems. The complete monitoring plan, including study design and analysis protocols, should be made available for public review and comment before a decision is made to revise the forest plan. The Center has specific questions about the monitoring plan, including but not limited to: (1) criteria for selection of measurable indicators of change; (2) sampling design power analysis and expected observational error rates; (3) sampling procedures including monitoring cycle; (4) confidence levels to be applied in data analysis and reporting; (5) timeframe for evaluation of results; (6) triggers for management adaptation using new information; and (7) funding sources. Reliance on statements of desired conditions for the PNVT types as a proxy for species viability, and the agency's ability to realize those desired conditions, is subject to significant uncertainty.

Furthermore, the spatial distribution of each PNVT should be field-verified and mapped with a high degree of precision, and then monitored continuously if it is to be reliably and accurately used as a proxy for species viability. Professional opinion of agency workers regarding distribution of habitat is not a sufficient basis to meet NFMA species viability requirements. See Idaho Sporting Congress v. Thomas, 137 F.3d 1146, 1150 (9th Cir. 1998) (requiring public to receive the underlying environmental data from which the Forest Service experts derive their opinions and conclusions). The analysis must supply the public with ability to independently determine that use of the PNVT types described in the DEIS and draft plan are reliable and accurate proxies for species viability, as required by NFMA. See 36 C.F.R. § 219.19 (1982) ("For planning purposes, a viable population shall be regarded as one which has the estimated numbers and distribution of reproductive individuals to insure its continued existence

is well distributed in the planning area […] [H]abitat must be well distributed so that [] individuals can interact with others in the planning area.").

Habitat-proxy approaches to species viability have rarely been tested in any context (Martino et al. 2005). Lawler and others (2003) compared the ability of seven taxa (freshwater fish, birds, mammals, freshwater mussels, reptiles and amphibians) to indicate the viability of other species assumed to associate with similar habitat in the Middle Atlantic region of the United States. No taxonomic group provided protection for more than 58% of other species (Lawler et al. 2003 - Table 2). The documented shortcomings of a taxon-based or habitat-proxy approach is linked to the rarity of some species. For example, 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 performed relatively well as an indicator group, but their viability accounted for an average of just 84% of all species.
In addition to this overlap problem and uncertainty regarding the effectiveness of a target species approach to conserving ecosystem diversity in general, and species viability in particular, other sources of uncertainty also must be considered, including: (1) species-specific habitat associations, (2) the validity of vegetation modeling, (3) population fitness, and (4) cumulative effects over space and time. Examples of cumulative effects include competition of non-native species, and habitat conditions on non-federal lands, which are inadequate to support viable populations of fish and wildlife.

Indicator species

The draft plan's identification of management indicator species ("MIS") is highly controversial because it: (1) fails to capture the range of PNVT that host species whose viability is of planning concern; and (2) significantly changes course from the current Forest Plan (USDA
1987), which designates a wider range of MIS that better represent habitats found on the Coconino National Forest, in keeping with the requirements of NFMA. Together, those species are assumed to indicate management effects on other species associated with a small portion of the Coconino National Forest.

The draft plan proposes a change of management direction from the current Forest Plan (USDA 1987) by omitting several MIS that have been used to measure effects of management activities on habitats and species whose populations must remain viable under NFMA. There is no explanation for this drastic change of course.

NFMA implementing regulations obligate the Forest Service to monitor population and habitat trends of MIS. See 36 C.F.R. § 219.19(a)(6). The agency admits failure to monitor threatened Mexican spotted owl, as discussed above. Therefore, any estimate of management effect to viability is arbitrary and capricious. Monitoring failures cast doubt on conclusions in the DEIS that the draft plan will maintain viable populations of proposed MIS.

Riparian habitat

NFMA implementing regulations require forest plans to make special provision for the ecological integrity and function of riparian areas:

Special attention shall be given to land and vegetation for approximately 100 feet from the edges of all perennial streams, lakes, and other bodies of water. This area shall correspond to at least the recognizable area dominated by the riparian vegetation. No management practices causing detrimental changes in water temperature or chemical composition, blockages of water courses, or deposits of sediment shall be permitted within these areas which seriously and adversely affect water conditions or fish habitat. Topography, vegetation type, soil, climatic conditions, management objectives, and other factors shall be considered in determining what management practices may be performed within these areas or the constraints to be placed upon their performance.

36 C.F.R. § 219.27(e) (1982). Current management direction (USDA 1987), as amended, clearly is not adequate to meet NFMA requirements for riparian areas (USDA 2009). Indeed, no fewer than 18 species are at imminent risk of extinction due to riparian habitat degradation in the Coconino National Forest. Nevertheless, the draft plan proposes no new management direction
to remedy the situation. It would repeal existing standards and guidelines that establish measurable protection for stream banks, flow regimes, water quality and other features of aquatic habitat in the existing Forest Plan (USDA 1987). The only relevant plan direction does not remedy the currently degraded condition of riparian areas or assure viability of species
dependent on properly functioning aquatic habitat.

The Forest Service should disclose in the EIS what it knows about the existing condition of aquatic ecosystems and associated species on national forest lands, particularly at-risk fishes amphibians and reptiles, and their food resources. NEPA requires the Forest Service to take a hard look at the success or failure of the existing Forest Plan (USDA 1987), as amended, and so- called "best management practices" at meeting statutory and regulatory requirements to provide for fish and wildlife viability.

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. 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, Seager and Vecchi 2010).

An ecosystem approach is warranted to stop riparian habitat degradation, maintain aquatic ecosystems that are currently in good condition, and to aid recovery of at-risk species. Federal land management cannot arrest all sources of population declines or degradation of aquatic habitats, such as artificial stocking and non-native species invasions, but the Forest Service can implement standards and guidelines to maintain and restore aquatic ecosystems and riparian habitats on national forest lands. This approach is both prudent and necessary given the current perilous state of many native fish, amphibian and reptile populations.

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). These natural processes and ecosystem-level interactions cannot be maintained by focusing on specific habitat. In fact, one of the main reasons for lack of progress in delisting aquatic species is the historical approach of focusing on habitat instead of complete ecosystems (Williams et al. 1989).

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 native communities of organisms 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).

The Center reiterates its prior proposal of an ecosystem-scale aquatic conservation strategy ("ACS") as an action alternative in the revised forest plan. The Forest Service adopted such an ecosystem approach to management of aquatic habitat and at-risk fisheries in a Record of Decision for federal lands within the range of northern spotted owl in the Pacific Northwest. It designates "key watersheds" in large drainage basins that offer the highest quality aquatic habitat to support recovery of fish populations. Fishes are reasonable indicator species for the health and function of aquatic systems. Key watersheds tend to host large areas of upland terrestrial habitat without roads where aquatic organisms enjoy the greatest likelihood of persistence. Key watersheds are withdrawn from programmed timber harvest and increases of road density are prohibited. The ACS further designates "riparian reserves" as a discrete land allocation within specified distances from streams or wetlands where the management must maintain or restore aquatic habitat. Standards and guidelines for active management of riparian reserves require proposed action to meet or "not prevent attainment" of discrete "ACS objectives" related to physical, chemical and biological properties of aquatic

ecosystems (USDA
1993). In addition to establishing management areas, or land allocations, the ACS compels the Forest Service to undertake watershed analysis at the scale of large drainage basins (~50,000 acres) to account for critical factors affecting aquatic habitats including road density, vegetation cover and geologic stability, among others. Active forest management in key watersheds and

riparian reserves, as well as site-specific designation of riparian reserves, is preceded and informed by watershed analysis (USDA 1993). Moreover, the ACS calls for restoration of aquatic ecosystems where past management activities have degraded indicators of ecological function, as expressed by the ACS objectives. Examples include road density reduction, removal of in-stream structures and cessation or regulation of livestock grazing in floodplains and wetlands, as well as a prohibition on use of mitigation or planned restoration in site-specific project activities as a substitute for preventing degradation of existing high-quality aquatic habitat (USDA 1993).

The Center again 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 and best management practices, even if fully funded, implemented and monitored, are inadequate to meet statutory and regulatory requirements to provide for viable fish and wildlife populations that depend on aquatic habitats. Clearly, more protective standards and guidelines that constrain management are required. Carrying forward or modifying existing standards and guidelines to make them more protective of aquatic ecosystems would help the Forest Service meet statutory and regulatory requirements under NFMA.

In scoping comments dated December 10, 2010, the Center proposed a strategy to maintain and restore riparian areas and aquatic habitats, which the Forest Service appears to have ignored. The Center noted that the Forest Service amended land management plans in the
Pacific Northwest Region within the range of northern spotted owl to enact an ACS that:

* Designates key watersheds in large drainage basins that offer the highest quality aquatic habitat, which 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.

* Establishes riparian reserves as discrete land management areas parallel to streams, in proximity to wetlands, and on high-risk landslide terrain where the emphasis is to maintain and restore aquatic habitat.

* Enacts standards and guidelines for management in riparian reserves that require project-level actions to meet discrete objectives related to physical, chemical and biological aspects of aquatic ecosystems. Suggested plan standard: "Management actions in riparian reserve that do not meet the ACS objectives, or prevent their attainment, shall not be implemented."

* Requires watershed analysis at the scale of large drainage basins to account for road density, vegetation cover and ecological processes that contribute to aquatic habitat quality. Land management in key watersheds and riparian reserves must be preceded and informed by watershed analysis.

* Compels active restoration of aquatic ecosystems in compliance with standards and guidelines for riparian reserves. Examples of restoration activities include road density reduction, removal of developments and grazing from floodplains and wetlands.

* Prohibits use of site-specific mitigation measures or planned restoration activities as a substitute for preventing degradation of existing high-quality aquatic habitat.

The Center reiterates its advocacy of the ACS described above, and urges the Forest Service to consider it as part of the range of alternatives in the EIS for this plan revision and implement it regardless of the alternative chosen by the decision-maker. It is the only proposal that meets NFMA requirements for management of riparian areas and maintenance of species viability, and is consistent with the need for change (Revision Topic 1).

The Forest Service provides no explanation why it now proposes to abandon standards and guidelines in the current Forest Plan (USDA 1987) for management of riparian habitats. It is not revising this plan on a blank slate, but rather it is significantly weakening the existing plan, which has been in effect for many years. "[A]n agency changing its course must supply a reasoned analysis." Motor Vehicles Manufacturers Assoc. v. State Farm, 463 U.S. 29, 57
(1983). The Forest Service must consider the effect of the existing Forest Plan on NFMA mandates (e.g., riparian areas), explain why it is changing course by deleting or weakening standards and guidelines, and assess how those changes will impact the environment. Riparian areas present a significant issue for analysis because they are severely degraded on the Coconino National Forest, and the viability of species that depend on aquatic habitat hangs in the balance.

The Forest Service should analyze and disclose in the EIS what it knows about the existing condition of riparian ecosystems and associated aquatic species on national forest lands, particularly at-risk fish and amphibians, as well as their food resources. The Forest Service must take a hard look at the success or failure of the existing Forest Plan and so-called "best management practices" at meeting statutory and regulatory requirements to provide for fish and wildlife. The Draft Plan and DEIS mention several threats to riparian ecosystems, such as livestock grazing, historical pollution from mining activities, degradation from human motorized recreation, and water quantity shifts associated with climate change. All of these historical and current stressors can affect key ecosystem components and processes leading to arrest of ecological recovery (Steedman and Regier 1987). They may also cause 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 also has the potential to reduce water availability and habitat suitability for aquatic organisms (Seager et al. 2007). However, the Service provides no additional data as to the effect of these ecosystem stressors on current population levels and habitats of listed species and at-risk ecosystems. The Forest Service must disclose in the DEIS the current state of riparian and aquatic species habitat and viability and
how they have been impacted by the above mentioned stressors.

Moreover, the Center strongly urges the Forest Service to include measureable and enforceable standards and guidelines for activities within riparian areas. Livestock grazing is

currently permitted on most of the Coconino National Forest. The Forest has acknowledged historic overgrazing has damaged riparian areas. However, the Forest Service has not disclosed how this has impacted recovery of listed species. Additionally, while the Draft Plan limits grazing in riparian areas to only when it would cause "no significant deleterious effects to riparian structure or function," the Forest Service has acknowledged that a key contributing factor to riparian degradation is lack of enforcement capability. Due to the generalized and highly discretionary nature of the proposed guideline, the Center recommends that the guideline be replaced by a more enforceable and resource protective requirement. Specifically, the Draft
Plan should establish a buffer zone of at least 150 feet around riparian areas where grazing would not be permitted. The inclusion of this proscriptive requirement is supported by data showing
that livestock grazing is a principal factor in stream bank erosion, increase in sediment pollution and turbidity, and loss of insect-supporting vegetation (Armour et al. 1990).

The revised forest plan should also include prohibitions on other activities within riparian areas. This includes a prohibition on logging, road-building, mining, and pesticide application within a designated buffer zone.

Additionally, management practices within riparian areas should only be undertaken if it can be shown that they will restore or protect riparian ecosystem functions or species viability. The plan should be revised to incorporate prohibitions or specific management strategies for all proposed activities within the guidance set forth for those specific activities. These changes are necessary to respond both to current degradation and the potential amplified negative impact from climate change if riparian areas are not restored.

In addition to adding substantive limitation and prohibitions for activities within the Forest, the Forest Service needs to address the reasons it has abandoned specific standards and guidelines for riparian areas that are found in the current management plan. The following specific standards and guidelines are present in the current plan, but are not incorporated into the Draft Plan or any proposed alternative:

*Manage riparian areas to protect the productivity and diversity of riparian-dependent resources by requiring actions within or affecting riparian areas to protect and, where applicable, improve dependent resources. Emphasize protection of soil, water, vegetation, and wildlife and fish resources prior to implementing projects.

*Give preferential consideration to resources dependant on riparian areas over other resources. Other resource uses and activities may occur to the extent that they support or do not adversely affect riparian-dependent resources.

The Forest Service provides no explanation in the DEIS why it proposes to abandon the standards and guidelines listed above. The Forest Service must explain why it is changing course by deleting or weakening standards and guidelines, and assess how those changes will impact the environment. Riparian areas present a significant issue for analysis because the Forest Service is required by NFMA to ensure viability of species that depend on riparian habitats, many of which are listed under the ESA. The Center recommends incorporation of the standards and guidelines listed above in any plan the Forest Service adopts.`

Water Quality

Forests are essential to clean water, and the Forest Service has a responsibility to protect water resources within National Forests. NFMA also specifically requires that forest plans make special provision for the ecological integrity and function of riparian areas. 36 C.F.R. § 219.27(e) (1982). However, the Draft Plan does not provide adequate provisions or protections for riparian areas, nor does any other proposed alternative. This is made clear in Table 60, located on page
312 of the DEIS, which estimates likely trends toward desired conditions for all riparian areas under all alternatives. This table clearly shows that under all alternatives, there is departure from reference conditions, and either "no change" is expected under proposed management or the alternatives would "slowly" lead to improvement in all riparian vegetation communities. DEIS at
311-312.

The requirement that the Forest Service make special provision for riparian areas is especially important in the Coconino. "Riparian areas make up less than 1 percent of the forest, yet are one of the most biologically diverse ecosystems." Draft Plan at 22. Unfortunately, many of the species that rely on these water-based ecosystems face an uncertain future. Ninety-three percent of the native fish species present in the forest are federally-listed or sensitive. Id. All of the native leopard frogs in the forest are either listed or sensitive species, and two of the four most imperiled species on Southwestern Forest Service lands, the Little Colorado spinedace and spikedace fish species, are located within streams on the Coconino. Id. All of these species are dependent on water within the Coconino and can be profoundly affected by changes in water quality.

The most troubling component of the Forest Service's analysis of the impact of management decision on water resources within the Coconino National Forest is the statement that "the amount of human and livestock

disturbances in riparian areas would be similar among all alternatives and would probably equally impact riparian function." DEIS at 61. First, this points to the inadequacy of the alternatives analysis, which requires development of alternatives that "[r]igorously explore and objectively evaluate all reasonable alternatives." 40 CFR § 1502.14. Second, this is troubling because the current state of riparian ecosystems on the Coconino is impaired and degraded, and if the Draft Plan will result in the same state as is currently found under management from the Current Plan (Alternative A), there is little hope that fish and wildlife species will be able to recover. Finally, if the Final Plan includes only the desired conditions, objectives, standards, and guidelines presented in the Draft Plan for grazing, off-road vehicle use, and road maintenance, which are inadequate to address historical and continuing use and misuse, it is more than likely that riparian areas will become more degraded, not less, over the time this plan is implemented.

The current condition of riparian areas in the Coconino highlights the problems with past management and the need for increased protection for these areas within the Final Plan. Twenty- three percent of riparian areas are "functioning at-risk" and six percent are "nonfunctional." DEIS at 67. In its discussion of the Affected Environment for Riparian Forests, the DEIS states that "legacy of improperly located and poorly maintained roads (especially user-created roads)", "dispersed recreation", "legacy off-highway vehicle use", and "legacy grazing" are the threats
faced by every impaired or at-risk watershed within the Coconino. DEIS at 68. However, none of these threats is adequately addressed or mitigated within the Draft Plan. Moreover, even though

the DEIS discusses these threats within the Draft Plan and DEIS, the main risk factor identified by the Forest Service for Riparian Forest PVNTs within the Coconino is "uncharacteristic fire." Id. at 309. While fire does have the potential to remove vegetation and increase negative effects associated with flooding and sedimentation into riparian areas, it is misleading to classify this as the "main risk factor," thereby downplaying the significant and negative effects on water quality and riparian function from human-caused and permitted activities.

The Cumulative Effects section of the DEIS related to "Water and Riparian Resources" is completely inadequate and does not meet NEPA standards. DEIS at 85; 40 C.F.R. §§ 1508.7,
1508.8 1508.25 (2013). As it is currently written, this section only identifies which threats to water and riparian resources the Forest Service does and does not have control over. It does not describe how the various threats and activities that take place on and off the forest cumulatively impact water and riparian resources. An example of the insufficiency of this section is the way in which it addresses drought, an extremely significant threat to water and riparian resources with serious effects: "Drought is another influence that is outside of forest control." DEIS at 85. The Forest Service must supplement this cumulative effects analysis and include discussion of how drought and climate change, along with other human and livestock activities, will likely cumulatively affect water quality and riparian resources over the life of the forest plan based on proposed management strategies.

Roads

In the Draft Plan, the following is stated as a desired condition for Roads and Facilities within the forest: "Temporary roads that support ecosystem restoration activities, fuels management, or other short-term projects are rehabilitated promptly after project completion. Unneeded roads are closed or naturalized to reduce human disturbance to wildlife and to reduce soil erosion. Some closed roads are converted to motorized trails or nonmotorized trails for recreational use." Draft Plan at 91-92. We recommend changing the final sentence of this desired condition to "Some closed roads are converted to nonmotorized trails for recreational use when such use conforms with habitat and species recovery plans, will not result in degradation of natural resources, and replaces other planned new trail development within the forest."
Moreover, all of these conditions should be changed to be standards or guidelines, as their language and prescriptions are better suited for project-level guidance as opposed to general goals.

Sediment pollution is also currently a problem in many of the streams within the Coconino. According to the

DEIS, the most important source of non-point pollution in the Forest is "sediment generated from roads near drainages." DEIS at 56. The DEIS also identifies the
main contributing factor for nonpoint source pollution on the Coconino as "sediment generated from roads near drainages." Id. The Forest Service goes on to mention only one management strategy imposed to deal with this problem, which is "implementation of BMPs for all projects that have the potential to increase nonpoint pollution." Id. All other strategies cited deal with controlling point source pollution. Id.

The following is listed as a guideline for Roads and Facilities in the Draft Plan: "Stream crossings on permanent roads should be designed to provide the most cost efficient drainage

structure consistent with resource protection, including safe passage of native aquatic organisms, and consider infrastructure needs and legal obligations." Draft Plan at 93. This guideline is not sufficient to tackle the ongoing problem of sediment pollution from roads. The guideline should be changed to read: "Stream crossing on permanent road shall be designed to provide the most effective drainage structure designed to ensure resource protection, safe passage of native aquatic organisms, and prevention of pollution and sedimentation of streams."

Off-Road Vehicle Use

One threat that is common to all riparian areas on the forest, according to the Forest Service, is dispersed recreation. DEIS at 67. "Dispersed recreation has the potential to disturb riparian vegetation and bank stability." Id. As a result, there is increased soil erosion and sedimentation of streams, both of which damage aquatic species habitat and impair water quality. Id. Due to limited enforcement and misuse, the negative impact on water resources from off-road vehicle ("ORV") use in riparian areas has contributed to increased sedimentation into streams within the Coconino.

In order to combat the negative effects of off-road vehicle use on water quality, the Forest Service should close and decommission any ORV trails that cross streams or are near riparian areas where damage to riparian or aquatic ecosystems is occurring or where off-trail use into streambeds, streambanks, or running water is occurring. We also recommend incorporating the following standards and guidelines from the Current Plan, see replacement page 159, as
modified, into the standards and guidelines for forest-wide dispersed recreation management within the Draft Plan. Draft Plan at 106-108 (FW-Rec-Disp-S, FW-Rec-Disp-G):

*Closely monitor off-road driving. If damage is occurring or becomes imminent, close affected trails or areas to off-road vehicle use.
*Focus media attention on off-road driving damage in these sensitive areas at least annually.

Livestock Grazing

Arid lands in the Southwest are particularly susceptible to damage from livestock grazing. (Agouridis et al. 2005). Grazing destroys vegetation, displaces soil, and consumes enormous quantities of water to the detriment of native species and the ecosystems on which they depend. (Belsky et al. 1999; Belsky and Blumenthal 1997). Moreover, climate change and
drought are exacerbating these impacts and if grazing remains at current levels, are anticipated to lead to increasing soil erosion, dust generation, water pollution. (Beschta et al. 2013).

The Forest Service has repeatedly identified livestock grazing as a source of water quality degradation and a stressor for aquatic ecosystems. However, the Forest Service provides no data or analysis within the DEIS to suggest that the proposed standards and guidelines for livestock grazing will result in an improvement in riparian or aquatic ecosystem function within the Coconino. Additionally, the Forest Service does not even mention livestock grazing in its discussion of water quality within the DEIS. See DEIS at 54-56. The only management

directive related to grazing that is stated as having a beneficial impact is the previous removal of lands

along parts of Verde River from grazing permitting that "resulted in improved riparian conditions along the river during the last 10 years." DEIS at 77. It is not clear why additional limitations and restrictions on grazing near rivers and in riparian areas were not considered
within the DEIS. This is a significantly different consideration than the dismissed alternative that called for no grazing within the Coconino, and should be adequately evaluated or discussed as a reasonable management strategy.

The Center is especially concerned with the continued authorization of grazing within sensitive riparian areas, such as those near Fossil Creek and the Verde River. As detailed in the Environmental Assessment completed for the renewal of the Fossil Creek Allotment Grazing Permit, the majority of acres that have been used for livestock grazing within this area contain soils that are either "impaired," "unsatisfactory," or "inherently unstable." (USDA May 2013:
55, tbl8). These types of soil conditions contribute to increased sedimentation of streams, turbidity, and overall decreased ecological function of riparian and aquatic ecosystems.

The Forest Service states that "[t]he rate of improvement of soil conditions [within grazing allotments] would depend heavily on climate conditions." (USDA May 2013: 64) It is unlikely that rangelands will return to historical reference conditions that supported grazing activity in the past due to the effect of climate change in the Southwest. (Seager and Vecchi
2010: 21282). Moreover, the Forest Service previously acknowledged a general decline in range condition between 1998 and 2006 on the Fossil Creek Allotment. (USDA May 2013: 9). This decline was attributed to "drought coupled with livestock grazing." Id. Going forward, it is likely that drought will be a common occurrence on the Coconino and that livestock grazing will have a more detrimental impact to the vegetation and soil structure on grazing allotments.

The Forest Service notes that due to water rights held for livestock grazing, it is "not feasible to preclude this activity from all wetlands." DEIS at 281. However, allowing for a case- by-case exemption due to state issued water rights, the Forest Service can restrict livestock grazing to areas outside of wetlands and riparian areas. We recommend incorporating the following standard creating buffer zones into the Plan sections addressing Livestock Grazing, Draft Plan at 79-80:

*Livestock grazing shall not be permitted within a quarter of a mile from riparian areas, wetlands, or seasonally present water, except as necessary to allow for continued use of state-issued water rights as allowed under Arizona State law.

The benefits of riparian buffers in grazing management are numerous and include: "stabilization of streambanks, the filtering of runoff, the reduction of peak floods, and the enhancement of habitat by controlling water temperatures and providing shelter to wildlife." (Agouridis et al. 2005: 598).

Additionally, the current monitoring plan proposed for the Coconino is not sufficient to accurately track and monitor the impacts of grazing on riparian and aquatic ecosystems. Therefore, we recommend the Forest Service incorporate a modified version of the monitoring guidelines for livestock grazing included in the Current Forest Plan, New Page 66-1, into either the forest-wide monitoring strategy. These guidelines should require identification of key forage

monitoring areas both inside and outside of riparian areas and wetlands, identification of key monitoring species to assess grazing impacts on riparian and aquatic ecosystems, and a timeline for analysis of impacts both during and after permitted grazing periods.

Due to the projected decreased in the number of livestock in counties surrounding the Coconino, USDA 2009 at 14, and the fact that riparian areas account for only one percent of forest lands, it is reasonable for the Forest Service to consider and implement additional management strategies for livestock grazing within the Forest Plan that would decrease the negative effects of this permitted activity on water resources.

Ground Disturbance

The Draft Plan establishes a guideline for water quality management that states "[TMDL] recommendations or implementation plans should be considered and implemented as appropriate [as determined by a forest interdisciplinary team." Draft Plan at 20. It is unclear from the discussion provided in the Draft Plan and DEIS what circumstances would preclude the application of TMDL recommendations or implementation plans from being used for water quality management in Forest. The Center recommends clarifying this direction and identifying reasons why the forest team would decide not to implement TMDL guidance.

In the third stated guideline for Water Quality within the Draft Plan, the Forest Service states that "[b]est management practices for ground disturbing activities in and outside of streamside management zones should be identified, implemented, and monitored to maintain water quality . . . ." Draft Plan at 20, emphasis added. "Ground disturbing activities" as defined in the Draft Plan, to which that phrase in the previous sentence is linked, covers only "[a]n activity which moves soil to the extent where an archeological site may be impacted." Id. at 196. This definition is too narrow to fully encompass the numerous activities that may disturb soil. The Forest Service needs to provide a broader definition for these activities. We recommend incorporating the following definition for "ground disturbing activities" into the plan: "an activity that has the potential to cause disruption to soil placement or quantity."

One of the primary water quality problems identified in the Coconino is the presence of E. coli within Oak Creek and the Upper Verde River watershed. According to the DEIS, this accounts for 33 miles (15 percent) of streams that are classified as Class 5 (impaired). DEIS at 5. However, the Draft Plan provides no desired conditions, objectives, standards, or guidelines that address or attempt to respond to this problem. The primary cause of this activity is septic system leaks and recreational swimming. This human caused pollution should therefore be a relatively easy target for the Forest Service to try to minimize and prevent.

To address this issue, we recommend incorporating the following standards or guidelines for water quality into the Final Plan:

*Monitor water quality during periods of high recreational use to determine if State water quality standards for primary contact recreation are being violated.
*Restrict access and human use in areas where water quality is failing to meet State water quality standards until such time as water quality has been restored.

We would also like to see language in the Final Plan that suggests a strategy of working with private landowners to educate them about the dangers to human health, water quality, and fish and wildlife habitat posed by old and leaking septic tank systems. This is an easy to implement management strategy that would begin to address another major contributor to E. coli pollution problems that is also within the ability and scope of the Forest Service's management role in the Coconino National Forest.

The Forest Service also fails to mention or discuss the use of reclaimed water within forest boundaries. While specific projects utilizing reclaimed water, as well as their approval, are outside the scope of the Draft Plan and DEIS, their potential impact on water quality within the forest is significant enough to merit discussion within the cumulative effects analysis and also to merit specific standards and guidelines pertaining to reclaimed water use. Given the ongoing drought and significant demand for water within the forest, it is advisable and necessary for

the Forest Service to address this and other potential outside water sources in a meaningful way within the Final Plan.

Finally, in the DEIS section addressing Aquatic Systems, there is a paragraph concerning wilderness and wildfire that seems to be misplaced. DEIS at 56, paragraph 3. We would ask that this passage is either removed or is edited to provide additional clarification as to why it is relevant to the discussion of water quality.

Water Rights

It is commendable that the Forest Service has identified guidelines for water quantity that include obtaining instream flow water rights. This is an important and necessary management practice to ensure continued stream flows that support aquatic and riparian ecosystems.
However, the management approaches and guidelines presented in the Draft Plan are not sufficiently clear to allow for assessment of how the Forest Service will structure its activities to obtain these rights or for which streams they will seek instream flow rights. The Forest Service can obtain instream water rights from the Arizona Department of Water Resources only through a lengthy process that requires submission of five years of streamflow measurement data after the initial application is accepted. ARS § 45-152.01 (2014). According to the DEIS, the Forest Service already has submitted an application and is tracking streamflow measurements for four streams. DEIS at 57. Additionally, six streams in the Coconino already have certified water rights held by the Forest Service for instream flows. Id. This is excellent progress, but more substantive guidance on tracking streamflow and identifying streams requiring instream flow
rights is needed in the Final Plan. Moreover, the Forest Service has acknowledged that a detailed analysis of water supply on the Coconino has not been done. Id. at 58.

Under NFMA regulations, monitoring within forest management plans must provide "[a] quantitative estimate of performance comparing outputs and services with those projected by the forest plan," as well as "[d]ocumentation of the measured prescriptions and effects," in order "to determine how well objectives have been met and how closely management standards and guidelines have been applied." 36 CFR § 219.12(k) (1982). The Draft Plan currently includes the following desired conditions for the Coconino : "Adequate quantity and timing of water flows

are maintained . . . ", "Water quantity (base flows) of intermittent and perennial streams are seasonally sustained while peak flows and flood potential occur within the historic range of variability for that stream system, " and "New and existing instream water rights are maintained and procured to ensure that enough water is guaranteed for habitat needs. . . ." Draft Plan at 20. Without including monitoring requirements for water flows and supply, there is no way for the Forest Service to meet NFMA requirements to provide quantitative estimates for water quantity to track progress on the water quantity goals and guidelines contained in the forest plan.

To remedy this problem, we recommend incorporating a monitoring question that asks "What are the status and trends for water supply and streamflow within the Coconino National Forest?" This monitoring should take place forest-wide and use the same methods used to track streamflow measurement data for instream water rights applications. This monitoring, which we would suggest completing annually on a seasonal basis, will allow the Forest Service to identify the success or failure of meeting the desired conditions and guidelines for water quantity contained in the Draft Plan. Additionally, such monitoring will give the public a better understanding of water supply trends in the Coconino leading to better management decisions and public awareness about water resources.

Roads

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 in particular cause significant downstream sedimentation, largely resulting from channel fill around culverts and subsequent road crossing failures (Furniss et al.
1991, Trombulak and Frissell 2000). Road-stream crossings create unnatural channel width, 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). Endicott (2008: 2) observed that road construction and maintenance at stream crossings "may involve point source discharges of dredged or fill material which may require a [Clean Water Act] section 404 … permit." More:

Unpaved roads and stream crossings are the major source of erosion from forest lands (Anderson et al., 1976, Megahan and Kidd, 1972; Patric, 1976; Rothwell,
1983), contributing up to 90% of the total sediment production from forestry operations. Surface erosion rates from roads are typically at least an order of

magnitude greater than rates from harvested areas, and as much as three orders of magnitude (1,000 times) greater than erosion rates from undisturbed forest soils (NCASI, 2001) [sic].

Endicott (2008: 9). The distance that sediment travels is an important factor in determining how much eroded soil is delivered to a water body. Soil losses and erosion occurring closer to a stream have greater potential to deliver sediment and lead to water quality impairment than erosion farther away from streams. For this reason, road-stream crossings have high potential to adversely impact water quality (Endicott 2008). The Forest Service must account for these factors and disclose potentially significant impacts that may result from the existing road network. In addition, the Forest Service should consider and analyze an action alternative in the EIS that features standards prohibiting new road construction, requiring no net-increase of road density in key watersheds, and an objective encouraging reduction of road density in each fifth-field watershed to less than two miles per square mile. In addition, it should prioritize management approaches that remove roads affecting aquatic ecosystem functions.

Despite the lack of studies looking at effects of post-fire road use, it is likely that roads will contribute most to sediment production in the post-fire environment, just as they do in unburned forest (Beschta et al. 2004, McIver and Starr 2000, Karr et al. 2004). Roads contribute more sediment to streams than any other anthropogenic feature on the landscape (Gibbons and Salo 1973, Meehan 1991). Beschta (1978) reports that mid-slope roads on steep terrain are the primary contributors to increased sediment production during logging operations. Swank and others (1989) estimated that while erosion after logging was seven times greater than in undisturbed areas, erosion rates on landings and roads were 100 times those of undisturbed areas.

Furthermore, a large body of literature describes negative effects of timber harvest and fragmentation by forest roads on amphibian and fish populations and habitats (e.g., Beschta et al.
2004, Karr et al. 2004, Trombulak and Frissell 2000). Few studies have measured the combined effects of wildfire, timber harvest and roads in a context similar to the proposed action. The Wallow fire significantly affected riparian habitats in the action area, and many such habitats and at-risk fish populations were impaired by

past management even before the fire (USDA 2008b, 2008c). Research on synergies between wildfire and mechanical disturbance will be especially important in areas where timber harvest is proposed after wildfire because characteristics of forests that have been salvaged logged (e.g., reduced recruitment of large wood and increased soil heating - Lindenmayer and Noss 2006) suggest that the combined effect of wildfire and harvest could be more harmful to forest amphibians and fishes than either factor alone. Negative interactive effects of wildfire and timber harvest or fragmentation by roads may be more likely for isolated populations, where there are greater physiological costs of dispersal and reduced likelihood of rescue from neighboring populations. This is of special concern for populations of federally-listed and sensitive species that may be affected by the revised forest plan. Uncertainty regarding potentially significant effects merits disclosure.

Reference conditions

The Forest Service stated that the current Forest Plan (USDA 1987) "does not provide clear desired condition descriptions of vegetation," and listed desired conditions including

restoration of forest ecosystem resilience and fire regimes (USDA 2009). It should explicitly define use in the EIS of the terms, "sustainable," "appropriate," "restore," and "resilience." We discuss below reasons why reliance on an arbitrarily defined reference conditions is not inherently "sustainable," nor would it promote "resilience," given ongoing climate change and the impossibility of achieving or sustaining pre-settlement conditions.

Restoration is an appropriate management objective for the Coconino National Forest, and we recommend application of 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 meaning of this definition. Historical fire exclusion, livestock grazing and logging have altered ecological conditions such that existing systems are vulnerable to catastrophic loss and require active management to reduce fuels and restore adapted ecological processes including fire (USDA 2009). However, this idea is controversial in many PNVT because there is evidence that stand- replacing fires are part of the historic range of variability for mixed conifer PNVT in the planning area (eg, Odion et al. 2014). In many cases, passive restoration including cessation of activities that degrade ecosystems (e.g., fire exclusion and livestock grazing) may be sufficient to accomplish restoration, particularly in roadless areas where historical management has had little, if any, direct impact to forest ecosystems (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 account for the foreseeable impacts of climate change (Choi et al. 2008, Millar et al. 2007).

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). Coarse-scale assessments of "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). The EIS is the appropriate vehicle for a science-based, landscape-scale assessment of forest restoration need.

Large areas of the Coconino National Forest remain little disturbed by human management and closely resemble conditions in which indigenous life evolved (DellaSala et al.

2004). 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 et al. 2004). 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 (SER 2004). Descriptions of natural variation in ecosystems derived from historical ecology and their application as reference conditions to land management are matters of controversy (e.g., Allen et al. 2002, Swetnam et al. 1999, Williams and Baker 2012). However, it is generally accepted that understanding historical ecosystem dynamics, structures and functions can provide useful information to guide restoration efforts (SER 2004).

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. 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. Consequently, there exists a need for streamlined monitoring protocols that simplify and improve efficiency of the task without compromising defensibility. The EIS is an
appropriate vehicle for proposing monitoring protocols that can be reliably implemented to support restoration-focused adaptive management.

Ecosystem resilience

According to the Forest Service, an additional "need for change" is to develop plan components to focus on restoration of fire-adapted ecosystems, including utilization of a wide variety of methods, including silvicultural treatments (USDA 2009). It is imperative that post- fire "salvage" logging after fire must not be equated with ecological restoration or forest management objectives other than economically-motivated multiple use. Noss and others (2006b: 485-86) caution that post-fire logging is counter to resilience of fire-adapted forest ecosystems for six reasons:

Our key findings on post-fire management are as follows. First, post-burn landscapes have substantial capacity for natural recovery. Re-establishment of forest following stand-replacement fire occurs at widely varying rates; this allows ecologically critical, early-successional habitat to persist for various periods of time. Second, post-fire (salvage) logging does not contribute to ecological recovery; rather, it negatively affects recovery processes, with the intensity of impacts depending upon the nature of the
logging activity (Lindenmayer et al. 2004). Post-fire logging in naturally disturbed forest landscapes generally has no direct ecological benefits and many potential negative impacts (Beschta et al. 2004; Donato et al. 2006; Lindenmayer and Noss 2006). Trees that survive fire for even a short time are critical as seed sources and as habitat that sustains biodiversity both above- and belowground. Dead wood, including large snags and logs, rivals live trees in ecological importance. Removal of structural legacies, both

living and dead, is inconsistent with scientific understanding of natural disturbance regimes and short- and long-term regeneration processes. Third, in forests subjected to severe fire and post-fire logging, streams and other

aquatic ecosystems will take longer to return to historical conditions or may switch to a different (and often less desirable) state altogether (Karr et al. 2004). Following a severe fire, the biggest impacts on aquatic ecosystems are often excessive sedimentation, caused by runoff from roads, which may continue for years. Fourth, post-fire seeding of non-native plants is often ineffective at reducing soil erosion and generally damages natural ecological values, for example by reducing tree regeneration and the recovery of native plant cover and biodiversity (Beyers 2004). Non-native plants typically compete with native species, reducing both native plant diversity and cover (Keeley et al. 2006). Fifth, the ecological importance of biological legacies and of uncommon, structurally complex early-successional stands argues against actions to achieve rapid and complete reforestation. Re-establishing fully stocked stands on sites characterized by low severity fire may actually increase the severity of fire because of fuel loadings outside the historical range of variability. Finally, species dependent on habitat conditions created by high severity fire, with abundant standing dead trees, require substantial areas to be protected from post-fire logging
(Hutto 1995).

The objective of post-fire logging is to remove commercially valuable trees not consumed by fire (Beschta et al. 2004). It results in long-term impairment of forest recovery and fire resilience by removing trees and snags that are, by definition, resilient to severe fire effects (Arno 2000, Lindenmeyer et al. 2008).

The unconsumed boles of large-diameter trees feature high surface area-to-volume ratios that limit the amount of oxygen feeding combustion, canopy biomass located high above the ground surface that resists ignition, and high water content that dampens fire intensity. Large standing snags and trees and large downed logs obstruct solar radiation and ground-level wind movement, and their microclimatic influences tend to moderate ground temperatures, increase moisture of live and dead fuels, reduce the speed and variability of surface winds, and inhibit extreme fire behavior compared to sites cleared by logging (McIver and Starr 2000). Predominance of large trees, snags and logs at stand scales reduces fire effects compared to their absence (Arno 2000).

The Forest Service should apply the full body of available science to describe possible trajectories of plant community succession after fire under the management objectives described for each alternative. Soil disturbance and movement of vehicles, equipment and personnel on burned sites increases the likelihood of weed invasion, with potentially significant impacts to ecosystem function and disturbance regime (Brooks et al. 2004, Lindenmayer et al. 2008). Untreated logging slash may inhibit plant growth, and logging operations may virtually eliminate nitrogen-fixing shrub and forb species (Donato et al. 2006). Inhibited regeneration of early-successional species may lead to localized extinctions of other species that restore site productivity after fire. Furthermore, inhibited plant regeneration would preclude burned slope stabilization and result in greater loss of topsoil and increased sedimentation in aquatic habitats than would occur in the absence of post-fire logging (Beschta et al. 2004). Loss of site

productivity is a costly impact of post-fire logging because of its deleterious effect on nitrogen and carbon cycling and on future forest growth (Lindenmayer et al. 2008).

Loss of soil productivity caused by loss of topsoil and inhibited early-successional plant regeneration is a long-term and irretrievable adverse impact to the forest ecosystem (Beschta et al. 2004). Recovery would not occur for decades because it would take that long for the ecosystem to replenish organic matter removed by post-fire logging that otherwise would decompose in situ. The effect of organic matter loss on site productivity is not well understood for lack of research (McIver and Starr 2000). The Forest Service should study this matter of scientific uncertainty and disclose its significance relative to the environmental impact of the plan revision.

Old growth forest

Past timber harvest destroyed nearly all ponderosa pine and mixed conifer old growth forests throughout Arizona and New Mexico, including on most of the Coconino National Forest, where regeneration silviculture and fire

exclusion established even-aged forest divested of structural diversity and adapted ecological functions (Covington and Moore 1994). Old growth forests differ functionally from younger forests in the habitat they offer to wildlife,
carbon storage, water filtration and flow regulation, and nutrient cycling (Kaufmann et al. 1992). The ecological significance of old growth featuring large trees is amply documented, whereas a scientific basis for logging large trees in pursuit of forest health or fire management objectives generally is lacking (Friederici 2003).

The mandatory viability requirement of the 1982 planning regulations require the Forest Service to adopt quantitative standards in forest plans that protect old growth forests and associated wildlife, including northern goshawk and Mexican spotted owl, as currently exist in the amended Forest Plan. Indeed, the Arizona and New Mexico Game and Fish Departments jointly commented to the Forest Service, "The conservation of spotted owl and goshawk habitats is closely related to the conservation of old growth forest ecosystems" (USDA 1995: Appendix F page 8). Any change 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 or federal listing.

Old growth forest habitat already has been identified by the Forest Service in past planning efforts as a significant issue for comparison of alternatives in NEPA analysis (USDA
1995). The EIS should provide a scaled analysis of the current status and projected future structure, composition, extent and distribution of old growth forest in the planning area and compare effects of management alternatives on this basis. The Center strongly recommends deferral of all old growth forest that meet standards and guidelines set forth in the current Forest Plan (USDA 1987), as amended (USDA 1996), from designation as suitable for timber harvest.

Such deferral also should apply a process-centered approach to restoration in old growth ecosystems emphasizing use of naturally-adapted fire disturbance, rather than a structurally- oriented approach that presumes to replicate spatial patterns of old growth that may have existed at any given time in history (Falk et al. 1996). The revised forest plan also should include

standards and guidelines that require assessment and designation of old growth habitat at site, watershed, and ecosystem scales, and allow management treatments within identified old growth only to enhance old growth characteristics, such as primary ecological functions mediated by
fire. Standards and guidelines should specifically address the problem of fragmentation of old growth habitat caused by past even-aged timber management and road construction, and apply spatially-explicit analysis demonstrating that functional old growth ecosystems will be sustained over time under any chosen management alternative. We recommend, consistent with the position of the Arizona and New Mexico Game and Fish Departments presented above, that the revised forest plan should contain goals and standards for maintaining and developing well- defined blocks of old growth forest in each project-level assessment area, in each Ranger District, and throughout the Coconino National Forest to insure a broad spatial distribution of old growth ecosystems across the landscape. See USDA (1995: Appendix F page 17).

Fire management

Anthropogenic forcing of atmospheric greenhouse gas concentrations is likely to contribute significantly to the potential extent and severity of wildland fires in the national forest over the life of the revised forest plan (Westerling et al. 2006). Increased frequency, extent and severity of unplanned fires may attend climate warming and drought (Gedaloff et al. 2005, Running 2006, Littell et al. 2009). 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, 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, and their tendency to retain moisture can deprive fire of heat energy. 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. 2006a).

The intensity of wildland fire behavior and the severity of its physical and biological effects to vegetation, soil, water quality and wildlife habitat depend, in part, on fuel properties and spatial arrangement. Fuel bed structure is a key determinant of fire ignition and spread potential and a central consideration in developing an effective management strategy (Graham et al. 2004). The bulk density (weight within a given volume) of ground fuels (e.g., grasses,
shrubs, litter, duff, and down woody material) influences frontal surface fire behavior (heat

output and spread rate) more than fuel loading (weight per unit area) (Agee 1996). In turn, surface fireline intensity dictates the likelihood of tree crown ignition and torching behavior (Scott and Reinhardt 2001).

The density, composition and structure of intermediate fuel strata consisting of tall shrubs and small trees also affect crown fire ignition potential because they can support surface fireline intensity and serve as "ladders" that facilitate vertical fire spread from the ground surface into overstory tree canopies. The size of the spatial gap in between ground fuel beds and tree
canopies strongly influences the crown ignition potential of a surface fire (Graham et al. 2004). Van Wagner (1977) quantified crown fire ignition rates when surface fires exceed critical fireline intensity relative to the height of the base of aerial fuels in tree crowns. Torching crowns (i.e., "passive crown fire") can develop into running canopy fires (i.e., "active crown fire" that spreads independent of surface fire behavior) if the spread rate surpasses a crown fuel density threshold that varies with slope angle and wind speed. Reducing the likelihood of active crown fire behavior on steep slopes or in extreme weather may require heavy thinning of dominant trees, depending on pre-treatment forest structure and degree of acceptable risk, and this is an element of the proposed management objectives. Predictions about the relationship of forest structure to crown fire hazard depend, in part, on the validity of crown bulk density calculations and
estimates (Perry et al. 2004). The environmental analysis should ensure professional and scientific integrity with site-specific information based on field observations (Weatherspoon and Skinner 1995).

Active management of the arrangement and volume of surface fuels and "ladder fuels" is effective at minimizing potential fire intensity in most circumstances (Graham et al. 2004, Graham et al. 1999). Some advocates contend that removing large or dominant trees can reduce crown bulk density and lessen fire resistance-to-control in extreme weather (Abella et al. 2006). Others question the premise of that contention on the basis that fire weather can overwhelm any effect of fuel treatments on fire behavior (e.g., Perry et al. 2004, Pollett and Omi 2002). To accurately assess fuel treatment effects on the likelihood of crown fire initiation and spread, it is necessary to consider: (1) surface fuel density and arrangement; (2) canopy base height; (3) local topography; and (4) weather patterns (Graham et al. 2004, Hunter et al. 2007). The former two factors can be actively managed in ponderosa pine and dry mixed conifer forest to significantly decrease the likelihood of crown fire initiation and spread without resort to large tree removal in most cases (Fielder and Keegan 2002, Keyes and

O'Hara 2002, Omi and Martinson 2002, Perry et al. 2004, Pollett and Omi 2002).

Perry and others (2004) investigated the relationship of forest structure to severe fire effects in ponderosa pine forests of the eastern Cascade Range. Even in areas far departed from historical conditions, "[T]here may be a great deal of landscape heterogeneity in the degree of risk and the treatments required to lower risk …" (Perry et al. 2004: 923). Fuel treatments that reduced surface fuel volume by fifty percent (50%) without any tree thinning prevented torching behavior in 13 of 14 experimental plots with modeled wind speeds exceeding 90th percentile conditions for the study area. A "light thinning" of trees smaller than 12-inches diameter coupled with surface fuel reduction prevented torching in the last plot (Perry et al. 2004: 924). Those results agree with Forest Service observations from the 2002 Hayman fire in Colorado,

where active crown fires dropped to the ground upon encountering areas that had been treated with prescribed fire to reduce surface fuels and kill small trees (Graham 2003).

Omi and Martinson (2002) measured the effect of fuel treatments on fire severity in highly stratified forest sites in the western United States and reported a strong correlation of crown base height with "stand damage" by fire. Importantly, crown bulk density did not strongly correlate with observed fire effects:

[H]eight 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.

Omi and Martinson (2002: 22). That research was retroactive and the scale of observed fire events confounds replication. However, it noted that results can be extrapolated to sites other than those studied, and its observation that large trees promote fire resistance is supported by Forest Service research (e.g., Arno 2000). A key implication is the importance of treating fuels "from below" in order to prevent widespread occurrence of stand-replacing fires (Omi and Martinson 2002). Keyes and O'Hara (2002: 107) agreed that raising canopy base height is an important factor in reducing fire hazard and noted, "[P]runing lower dead and live branches [of large trees] yields the most direct and effective impact." They also noted the incompatibility of open forest conditions created by "heavy" thinning treatments designed to maximize horizontal discontinuity of forest canopies with management objectives to conserve threatened wildlife populations and prevent rapid understory initiation and ladder fuel development. Understory growth following treatments that create open forest conditions may undermine their long-term effectiveness without commitments to maintenance treatments (e.g., prescribed fire).

The DEIS discusses a range of fuel management options, but notably, it does not consider the effect of activity-created fuels on fire hazard, nor does it propose any standards or guidelines for their treatment. Mechanical logging generates large quantities of slash fuels by relocating
tree stems, branches and needles from the overstory canopy to the ground surface (Graham et al.
2004, Stephens 1998, van Wagtendonk 1996, Weatherspoon and Skinner 1995). Logging slash produces higher flame lengths and more intense surface fires that can increase the probability of crown fire initiation compared to fuels that pre-exist logging operations (Dodge 1972, Naficy et al. 2010, Stephens and Moghaddas 2005). According to the Congressional Research Service,

Timber harvesting removes the relatively large diameter wood that can be converted into wood products, but leaves behind the small material, especially twigs and needles. The concentration of these "fine fuels" on the forest floor increases the rate of spread

of wildfires. Thus, one might expect acres burned to be positively correlated with timber harvest volume.11

Timber harvest and fuel management activities under the revised forest plan will immediately increase the density and volume of fine surface fuels up to 15 or more tons per acre, depending on pre-treatment forest structure, which will increase fire resistance-to-control and make wildfires more dangerous and severe where activity fuels are not effectively managed. Van Wagtendonk (1996) modeled the effectiveness of low thinning combined with a pile-and-burn slash treatment on flat ground, which yielded nearly identical post-treatment fire behavior as thinning without any slash treatment because pre-existing surface fuels were not significantly reduced. Lop-and-scattering of logging slash "significantly increased subsequent fire behavior" (van Wagtendonk 1996: 1160). Activity fuels may persist for decades:

In both even aged and un-even aged treatments, it is often assumed that harvest related slash will decompose over time thereby reducing fire hazards. In reality, logging slash may persist for long periods, and therefore, will influence fire hazards for extended periods. Rates of woody fuel decay are highly variable (Lahio and Prescott, 2004). The rates of decomposition of understory fuels are primarily dependant upon several factors including temperature, soil moisture, insect activity, and material size (Lahio and Prescott, 2004). Decaying conifer activity fuels have been reported to persist for 30 years in xeric forest environments (Stephens, 2004).

Stephens and Moghaddas (2005: 377). Prescribed burning is the only treatment that effectively reduces activity fuels and fire hazard below pre-logging conditions (Stephens 1998, van Wagtendonk 1996). "Periodic underburns and programs for restoring natural fire are critical to maintain these post-harvest stands" (Pollett and Omi 2002: 9). Burning is uniquely effective because fire consumes the finest and most ignitable activity fuels that pose the greatest hazard (Deeming 1990).

The Forest Service is required to disclose potentially significant effects of the project on public health and safety, including wildland fire control efforts. It should take a hard look at the effect of slash fuels and treatment options on fire hazard and ecosystem resilience, particularly on steep slopes where prescribed fire may not be used due to operability constraints, rather than generalizing them across the national forest. The analysis should disclose how much slash may remain on the ground after logging is completed in different vegetation types, and take a hard look at the effectiveness of activity fuel treatments.

The direction of fire spread (backing, flanking, heading) is an important consideration because fire interacts with weather, topography and vegetation to "back" and "flank" around certain conditions, or "head" through others as it spreads (Graham et al. 2004). Steep slopes can facilitate wind-driven convection currents that drive radiant heat upward and bring flames nearer

11 Gorte, R.W. 2000. Memorandum on Timber Harvesting and Forest Fires. Congressional Research Service, Library of Congress: Washington, D.C. August 22. Attached for convenience and available at: http://cnie.org/NLE/CRSreports/Forests/for-30.cfm (accessed April 25, 2013).

to adjacent, unburned vegetation, thus pre-heating fuels and amplifying fire intensity as it spreads upslope (Whelan 1995). As a result, severe fire effects often are observed to concentrate at upper slope positions and on ridges, whereas such effects are relatively rare on the lee side of slopes that do not directly receive frontal wind (Finney 2001). Therefore, fuel treatments should be oriented in concert with prevailing spatial patterns of fire spread in the project area. Overlapping fuel treatments that reduce fuel continuity can fragment extreme fire effects into smaller patches if they disrupt heading fire behavior and increase the area burned by flanking and backing fires (Finney 2001). Slope aspects facing away from frontal or diurnal winds are a lesser treatment priority because backing fires are the most likely to exhibit mild intensity and effects. The Forest Service should analyze these factors and demonstrate that proposed fire management program will meet the need for change.

An additional approach to the strategic location of fuel treatments is to identify landscape features that are currently resistant to severe fire effects and use them as anchor points for a compartmentalized landscape fire management strategy. Such features may include natural openings, meadows, relatively open ridges, moist riparian areas, mature forest patches with shaded and cool microclimates and little or no history of past logging (Naficy et al. 2010), and areas where fuel treatments already have been completed. Those features can support the strategic use of fire for resource benefits, application of confinement and containment strategies as alternatives to full control of unplanned fires, and provide safe areas for workers to ignite prescribed fires for hazard reduction and ecological process restoration. The analysis should consider such factors.

Finally, in our view, the Forest Service should prioritize fuel treatments at locations where relatively little resource investment may create fire resistant conditions in the shortest amount of time. Targeting initial work in this way will maximize the area treated with available funds and personnel, and provide the greatest opportunity to quickly reduce fuels and restore ecosystem function at larger spatial scales. It is not clear that the Forest Service has given its own research on this point requisite consideration in the PDEIS.

Retention of large trees is fundamentally important to fire resistance of treated stands (DellaSala et al. 2004). Large ponderosa pine and Douglas-fir trees possess autecological characteristics such as relatively thick bark and insulated buds that promote resistance to heat injury (Arno 2000,). Self-pruning mature ponderosa pines feature high branch structure and open canopies, which discourage torching behavior and promote capacity to survive and recover from crown scorch (Keeley and Zedler 1998). Thus, large tree structure enhances forest resistance to severe fire effects (Arno 2000, Omi and Martinson 2002, Pollett and Omi 2002), whereas removing them may undermine fire resistance (Brown et al. 2004, Naficy et al. 2010).

Research demonstrates no advantage in fire hazard mitigation resulting from treatments that remove large trees compared to treatments that retain them. Treatments that removed only trees smaller than 16-inches diameter were marginally more effective at reducing long-term fire hazard than so-called "comprehensive" treatments that removed trees in all size classes (Fiedler and Keegan 2002). Thinning small trees and pruning branches of large trees to increase canopy base height significantly decreases the likelihood of crown fire initiation (Graham et al. 2004, Keyes and O'Hara 2002, Omi and Martinson 2002, Perry et al. 2004, Pollett and Omi 2002),

which is a precondition to active crown fire behavior (Agee 1996, Graham et al. 2004, Van Wagner 1977). Low thinning and under-burning to reduce surface fuels and increase canopy base height at strategic locations effectively reduces fire hazard at a landscape scale and meets the purpose and need.

Large trees are not abundant at any scale in ponderosa pine or mixed conifer forests in the Southwestern Region (Covington and Moore 1994, Fulé et al. 1997, USDA 1999, USDA 2007, USDI 1995). They are the most difficult of all elements of forest structure to replace once they are removed (Agee and Skinner 2005). The ecological significance of old growth forest habitat and large trees comprising it is widely recognized (Friederici 2003, Kaufmann et al. 1992).
There is no scientific basis for extracting large trees to promote fire resistance in ponderosa pine and mixed conifer forest (Allen et al. 2002, Brown et al. 2004, DellaSala et al. 2004).

In addition to their rarity, a variety of factors other than logging threatens the persistence of the remaining large trees in Southwestern conifer forests. Prescribed fire can injure exposed tree roots that have migrated into accumulated duff layers and cause high levels of post-treatment mortality among large trees (Sackett et al. 1996). Burning of pine stands with high surface fuel loading also can produce high fireline intensities and result in large tree mortality due to cambial injury by heat (Hunter et al. 2007). Prescribed fire also may render large trees susceptible to delayed bark beetle infestation (Wallin et al. 2003). In addition, large tree mortality has indirectly resulted from mechanical thinning activities (Hunter et al. 2007). Large standing dead trees ("snags") and downed logs supply critical habitat for primary and secondary cavity-nesting species (including threatened Mexican spotted owl and its prey) and may be destroyed by fuel treatments (Hunter et al. 2007). Prescribed fire

may create coarse woody habitat by killing live trees, but gains generally do not offset losses, as existing coarse wood is irretrievably destroyed (Randall-Parker and Miller 2002). Recruitment of large trees, snags and large woody debris will become more limiting over time as climate change imposes chronic drought, reduced tree growth rates, and more widespread tree mortality (Diggins et al. 2010, Savage et al.1996, Seager et al. 2007, van Mantgem et al. 2009, Williams et al. 2010).

McHugh and Kolb (2003) describe unplanned and prescribed fire effects on ponderosa pine forest structure in northern Arizona reflecting a "U- shaped" tree mortality curve in which mortality was lowest among trees sized 30 - 60 centimeters ("cm") (approx. 12" - 24") diameter, and highest among the smallest trees as well as in the 75 - 80 cm (~29.5" - 31.5") diameter (Figure 3). Resistance to fire-induced mortality was greatest among trees sized 35 - 75 cm diameter.

Mortality effects occurred despite relatively uniform "crown damage" across tree size classes, indicating that cambial injury and root scorch fire effects were most significant among the smallest and largest trees, whereas intermediate-sized trees were relatively uninjured and may have benefited from the disturbance (McHugh and Kolb 2003). A large tree retention alternative would maintain trees that are most likely to survive fire injury and supply recruitment structure that will support the recovery of old growth forest habitat in the future.

If significant reductions of crown bulk density are necessary to meet the need for change then it is unlikely that the revised forest plan will maintain habitat for threatened and sensitive wildlife species associated with closed-canopy forest (Beier and Maschinski 2003, Keyes and O'Hara 2002, USDI 1995). Large tree removal reduces forest canopy and diminishes recruitment of large snags and downed logs, which in turn affects long-term forest dynamics, stand development, and wildlife habitat suitability (Quigley et al. 1996, Spies 2004, van Mantgem et al. 2009). A large tree retention alternative would maintain wildlife habitat in the short-term and mitigate adverse direct and indirect effects of proposed treatments.

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

Figure 1. Tree size class distribution in southwestern ponderosa pine forests. Source: USDA (1999, 2007).

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 (Agee and Skinner 2005, Brown et al. 2004). 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, including the White Mountains Stewardship Project on the Apache-Sitgreaves National Forests, which are focused on small-diameter thinning as a vital element of hazardous fuels reduction and
ecological restoration.

Climate change

Atmospheric concentrations of greenhouse gases clearly are increasing and influence global and regional climate systems (Alley et al. 2007, Seager et al. 2007). Abrupt climate change is imminent or underway in the southwestern United States (Cook et al. 2008, Seager et al. 2007, Seager and Vecchi 2010). It is caused primarily by the release of greenhouse gases from burning of fossil fuels, and it may accelerate if our use of fossil fuels is not substantially reduced (Alley et al. 2007).

One implication of these phenomena is that ecological restoration activities oriented to reference conditions based solely on historic conditions or ranges of variability may not be appropriate or sustainable (Flannigan et al. 2000, Frederici 2003, Johnson and Duncan 2007). Indeed, climate change, landscape fragmentation and noxious weed invasions preclude forest ecosystems from realizing settlement-era structural or compositional patterns even with active restoration that intends to emulate an HRV in forest structure, composition and fire disturbance regime (McGlone et al. 2009, Noss et al. 2006a). Johnson and Duncan (2007) proposed updating the HRV concept to a "future range of variability" that accounts for inevitable ecological change as disturbance regimes and vegetation pattern track climate. 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 (Choi et al. 2008, Stephenson et al. 2006).

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).

Furthermore, in assessing and describing the affected environment, the Forest Service must consider and disclose the extent and degree to which climate change affects national forest 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).

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 EIS on the plan revision, 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.

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 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, mature or old growth 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.

Forests are the most significant terrestrial stores of carbon, and in fact may slow global warming by storing and sequestering carbon. Through photosynthesis, plants capture carbon dioxide and convert it to plant matter that then feeds the base of the entire planetary food chain. Old-growth forests 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 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 (North et al. 2009) 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 (Heiken 2009). The Forest Service must consider and disclose the potential environmental consequences and climate change implications resulting from any anticipated continued commercial harvest of timber.

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 (Steinfeld et al.
2006). Livestock grazing is widespread on national forest lands, and the contribution of grazing to climate change must be assessed and disclosed (see, e.g., Beschta et al. 2012).

Fire is a fundamental component of Earth's natural carbon cycle, with a functional role that pre-dates human existence. Ecosystems occurring on the Coconino National Forest 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.

Alternatives

In its December 10, 2010 comment responding to the notice of intent for this plan revision, the Center requested that the Forest Service include an alternative that would provide a substantial increase in protection for plant and animal species, even at the expense of other forest uses. The Center maintains that such an alternative merits consideration due to the current degraded state of some forest ecosystems, foreseeable effects of climate change, and the goal of recovery and de-listing of species currently listed as endangered or threatened under the ESA. Additionally, NFMA requires that the Forest Service provide 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). The Coconino National Forest is a unique ecosystem that is especially suited to supporting biodiversity.

The Center recommends that the Forest Service consider the following additional requirements to be incorporated into an alternative that would focus on the preservation of biodiversity and species habitat while significantly limiting destructive forest uses:

*Explicitly require implementation of species recovery plans (i.e., site-specific activities "shall" implement recovery plans for federally-listed endangered and threatened species).

*Require all forest uses to be analyzed in light of current data about the foreseeable effects of climate change (i.e., environmental analysis of site-specific activities "shall" consider foreseeable cumulative effects of climate change to the affected environment).

*Require analysis of management effects to both water quality and quantity before approval or adoption of any site-specific action (i.e., analysis of site-specific activities "shall" consider direct, indirect and cumulative effects to water quality and quantity).

*Create buffer zones for vegetation management and grazing around riparian areas consistent with the ACS discussed above (i.e., riparian reserve).

*Require monitoring of listed-species habitat and aquatic resources, including surface waters and groundwater (i.e., site-specific activities "shall" include monitoring of effects to listed species and aquatic resources).

*Implement ecosystem-level management and restoration to protect and support aquatic and riparian species habitat (i.e., actions that do not meet, or that prevent attainment of ACS objectives, "shall" not be implemented).

*Provide specific limitations on future road and other infrastructure projects, especially those that could impact watersheds and riparian habitat (e.g., no net increase of road density in key watersheds).

This list is not meant to be comprehensive. It merely identifies broad requirements and limitations that should be more thoroughly considered in an alternative that focuses on maintenance of species viability and habitat, consistent with the Center's prior advocacy.

Consultation

The plan revision will affect ESA-listed plant and animal species that are threatened or endangered with extinction. Therefore, the Forest Service is obligated to consult with the 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). Forest plans are subject to formal consultation under the ESA. See Pacific Rivers Council v. Thomas, 30 F.3d 1050, 1051-52 (9th Cir. 1994); 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").

Thank you,

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