Society for Conservation Biology (SCB) Sponsored Review of Proposed Rule Change to the National Forest Management Act and Related Environmental Impact Statements

Submitted to U.S. Forest Service, 20 April 2011

Review Background:

The Society for Conservation Biology—a global community of conservation professionals of nearly 10,000 members with diverse expertise in conservation science—recognizes the profound importance to the United States and the world of scientifically informed management of U.S. National Forests and Grasslands. Accordingly, we decided to use our collective scientific expertise to organize and pursue a formal review of the proposed Rule change to the National Forest Management Act and related Draft Environmental Impact Statement (DEIS) with the hope of contributing in a positive and constructive manner to a successful Rule change outcome that is based on the best available science.

The SCB leadership invited Dr. Gary Meffe—a conservation biology textbook author and former Editor for 12 years of our flagship journal, *Conservation Biology*—to lead a review team to independently and critically examine the DEIS and other documents relevant to the Rule change. In particular, we identified five broad areas of focus that we felt to be especially important to future management of forests and grasslands: wildlife population viability; watershed integrity and water quality and quantity in relation to forest management practices; climate change adaptation; climate change mitigation (especially long-term carbon storage and sequestration from natural systems); and ecosystem restoration and resilience to climate change. We identified one widely recognized expert in each of these focus areas and sought their independent reviews. The reviewers knew each others' identities but did not collaborate on their reviews in any way. The only other person knowing their identities is Dr. Meffe. Thus, we attempted to maintain complete anonymity in the review process to ensure objectivity and eliminate any possible outside influences or pressures on reviewers. Consequently, we are confident that documents were reviewed with good science and management as the only motivations. The reviewers are of both genders and from geographically diverse areas. They represent universities, government agencies, and non-profit organizations, thus ensuring diverse backgrounds and perspectives. No two are from the same institution.

Review Summaries:

A brief summary of each of the five reviews is presented next, followed immediately by the five complete reviews. Each is identified by the area of focus they were asked to concentrate on. Overall, the reviewers consistently felt that Alternative A is a vast improvement over the status quo (Alternative B, which is scientifically indefensible) and that Alternative C is unacceptable. However, they also felt that Alternative A is not necessarily the best option and could be improved upon by either adopting Alternative D or E, or by making modifications, as indicated below. Carbon sequestration is not effectively addressed by any of the alternatives and is thus a glaring overall weakness. Climate change in general is not as well addressed as scientific knowledge would permit and that component should be strengthened significantly.

Reviewer # 1: Wildlife Population Viability.

The Forest Service has a legal mandate to maintain plant and animal diversity on U.S. national forests and grasslands. In the DEIS, the agency proposes to assess the effects of land management on biological diversity by employing broad-scale (coarse-filter) measures of changes to vegetation structure and composition and limited species-level (fine-filter) assessments. However, to reliably validate coarse-filter management actions, additional requirements for species-level monitoring are needed in the planning rule. Fortunately, recent advances in sample design, statistical models, and sign surveys allow for efficient species-level monitoring. The Forest Service can fulfill its legal mandate to maintain plant and animal diversity only if it manages so that individual species persist. I support Alternatives D and E because they give greater weight to the assessment of plant and animal diversity at the species level than the other alternatives. The need to validate the coarse-filter component of the species diversity strategy cannot be over-emphasized.

Reviewer # 2: Watershed Integrity.

The DEIS provides a thorough, well organized rationale for each alternative, as well as a thoughtful comparison among alternatives. Alternative A is soundly based on current scientific thinking, is a significant improvement over the status quo (Alternative B), and offers the 2nd-best choice for conserving biodiversity and key ecosystem services. Alternative C is the worst choice among given alternatives. Alternative D is the best choice for conserving biodiversity and ecosystem services but includes provisions that may make it politically unviable and less cost-effective than Alternative A. However, if certain provisions are omitted from Alternative D to form Alternative D1 (details below), these shortcomings are diminished and Alternative D1 becomes the preferred alternative.

Reviewer # 3: Climate Change Adaptation.

All of the alternatives do a fairly poor job of actually getting at the issue of climate change. Although the bottom line is meant to be management based on the best available science, the USFS seems to be pretending that there is no good science on climate change, therefore doing very little is an acceptable alternative. This should not be the case. In some ways the clear mandate in the framework of Alternative A is the most hopeful of the options for at least allowing those that have ambition to do good work the opportunity to take it on. While I am not one to provide prescriptive climate change management, I am also a fan of making the need for the inclusion of such work explicitly part of the basic mandate. Otherwise, tax-payer resources are squandered on management that is at best wishful thinking and at worst negligent and failing. Thus, climate change adaptation is poorly addressed in the DEIS.

Reviewer # 4: Climate Change Mitigation (especially carbon sequestration).

None of the alternatives presents a viable view of how carbon management will be factored into planning efforts. They all ignore carbon pools other than live carbon and are thus completely unrealistic. This approach does not represent the best available science, is a very serious weakness in the proposed Rule change, and must be addressed.

Reviewer # 5: Ecosystem Restoration and Resilience to Climate Change

The Proposed Rule (Alternative A) provides sufficient guidance to facilitate ecological restoration in the context of climate change, but to ensure the resilience of ecosystems, improvements are needed. The inclusion of the phrase "reestablishment of function" sets historical condition appropriately as the direction of restoration management, but the uncertainty associated with climate change demands that other management strategies also be tried. The Rule should include direction to allocate substantial portions of the national forests to reserve-style management, where change is simply observed, and other parts to creative, experimental management, where efforts to sustain resilience do not rely on the historical model. The language of Alternative D would be a common sense addition to the Proposed Rule but is not essential to facilitate restoration.

Complete Reviews:

Reviewer # 1: Wildlife Population Viability

The primary focus of my review comments pertain to section §219.9 of the Proposed Rules, "Diversity of plant and animal communities". In addition, I make reference to the intersection of section §219.9 with sections of §219.3, Role of science in planning; §219.6, Assessments; §219.8 Sustainability; and §219.12, Monitoring. I begin by first discussing the diversity and viability components of Alternative A, and then compare the other alternatives to A.

The preferred alternative (Alternative A) proposes to maintain the diversity of plant and animal communities within the plan area (e.g., an individual national forest) by invoking a combined coarse-filter and fine-filter strategy. The coarse-filter is operative at broad spatial scales (hundreds of square miles) and long temporal scales (generations to centuries). The broad spatial scale is intended to address requirements for maintaining ecosystem diversity. The Forest Service identifies three attributes of ecosystems--structure, composition, and function--which constitute components of the coarse-filter. The fine-filter is focused at the level of individual species and is intended to evaluate plan performance for those species not adequately covered by the coarse-filter.

The coarse-filter, fine-filter strategy has significant scientific support as a biodiversity planning tool (reviewed in Noon et al. 2009). In addition, this approach is justified by pragmatism alone. Because of limited resources, the Forest Service is unable to manage directly for the physical and biological requirements of all species within a plan area. This requires a surrogate or indicator approach to assessing the state of an ecological system. In practice, the coarse-filter approach is primarily based on maintaining on the landscape that combination of vegetation community types and successional stages expected under the historic range of variability. This broad-scale assessment is usually based on an analysis of remotely sensed data or forest survey data collected at multiple points in time.

The coarse-filter, fine-filter approach to conserve plant and animal diversity is common to Alternatives A, D, and E. Alternative C provides no specific requirements for maintaining viable plant and animal populations within the plan area. A coarse-filter approach (i.e., based on a species' "habitat" as defined by vegetation type and stage) has been shown to have limited power to predict the abundance and distribution of species (COS 1999; Noon et al., 2009; Schlossberg and King 2009). As the Committee of Scientists (COS) stated in their review of a previous planning rule, "Habitat alone cannot be used to predict wildlife populations" and "diversity is sustained only when individual species persist; the goals of ensuring viability and providing for diversity are inseparable." If emphasis is put primarily on the coarse-filter approach then the abundance and distribution of many species may be incorrectly inferred. The challenge to the Forest Service's conservation strategy is to determine an appropriate balance between allocation of time and resources to the coarse-filter or to the fine-filter.

Under Alternative A, the fine-filter is targeted at: 1) federally listed threatened or endangered species; 2) candidate species for Federal listing; and 3) species whose viability within the plan area is a concern (species of conservation concern). The DEIS describes this strategy as acting as a "safety net" to catch species not conserved by the coarse-filter approach. Two questions are relevant to this strategy: 1) are species that pass through the coarse-filter restricted to the above categories; and 2) who is responsible, and by what mechanism, to identify species of conservation concern? The designation of "species of conservation concern" is particularly worrisome because the Forest Service is apparently not assuming responsibility for their identification. This begs the question--what information will the Forest Service collect in order to identify species of conservation concern? Since viability responsibilities are restricted to this group of species, additional information is needed in the discussion of Alternative A and in section §219.9 on viability assessment.

In all alternatives (except C), the Forest Service limits its responsibility to species viability to the "inherent capability of the plan area." However, this concept is poorly defined in the DEIS and no details are given on its measurement. Since the inherent capability of the land area sets an upper limit to the Forest Service's responsibility to conserve plant and animal diversity, it is very important that it be clearly defined and guidance be provided on its measurement. Through this mechanism, the Forest Service is understandably trying to limit its responsibilities in those cases where the occurrence or viability of a species will be outside of its control. However, a clear discussion in the alternatives of the role of extrinsic conditions in affecting a species' population dynamics may be a better way to address limits to Forest Service responsibility.

The degree to which the various alternatives directly address conservation at the species level is quite variable. Alternative B relies primarily on evaluation of the status of management indicator species (MIS), and the MIS are restricted to vertebrates. Under this alternative, MIS would be monitored to estimate their temporal trends. The monitoring state variable(s) is not defined but would presumably include some estimates of abundance and/or distribution. Alternative C contains no specific requirements for addressing the diversity of plant and animal communities. Under this alternative, any effort directed toward plant and animal conservation would be at the discretion of the responsible official. This could lead to great inconsistencies among management units. It is also unclear if this alternative meets the National Forest Management Act's requirement to provide for the diversity of plant and animal communities across the National Forest System.

Similar to Alternative A, Alternatives D and E both incorporate a coarse-filter and fine-filter strategy to conserve biological diversity on Forest Service units. In addition, they emphasize restoration, the maintenance of landscape connectivity, and include fine-filter components focused on species viability. Alternative D varies from Alternative A by increasing its focus on fine-filter approaches to maintaining plant and animal diversity. This alternative does not contain the "species of conservation concern" designation. Rather, for fine-filter evaluations it relies on the concept of focal species similar to as defined in the 2000 Planning Rule and in the Committee of Scientist Report (COS 1999). Under D and E, undesirable outcomes of the status and trend of one or more focal species would trigger reviews of planning and management decisions. In Alternative A, few (or no) resources would be devoted to surveys of focal species and no monitoring "trigger" points are identified. Another significant difference between Alternatives A and D addresses the role of extrinsic conditions. In A, limits to Forest Service responsibilities to viability are set by the ambiguous concept of "inherent capability of the plan area." In D, the role of factors outside the control of the Forest Service that affect a species' abundance and distribution are directly recognized, but Forest Service activities are still constrained so as not to increase the likelihood of extirpation of a species' population in the plan area.

Under Alternative E, requirements for maintaining species viability are similar to those in Alternative A. One important difference for species with wide geographic ranges, or migratory species, is that this alternative requires considerably more coordination and collaboration across Forest Service units (section §219.4). This requirement would increase cross-boundary management and correctly expand conservation efforts to broad spatial scales (Wiens et al. 2002, Gutzwiller et al. 2003). Overall, Alternative E requires the Forest Service to devote considerably more resources to monitoring than the other alternatives, including the status and trend of focal species, vegetation diversity, invasive species, insect outbreaks, and environmental goods and services. Monitoring data of the sort required in Alternative E are essential to the adaptive management of complex ecological systems such as our national forests and grasslands.

The degree to which the planning alternatives are required to conform to the 'best available science' is unclear (section §219.3). According to the preferred alternative, for example, the rule only requires that the responsible official "take into account" or "consider" best available science. This leaves much room for local discretion, may result in decisions inconsistent with the best available science, and may result in extensive variation in management practices across national forests.

At least two major sources of uncertainty are relevant to the alternatives. These include uncertainties associated with assessing the impacts of management actions on plant and animal diversity and, second, on assessing the viability of species of concern. To address the first source of uncertainty the Forest Service proposes to manage adaptively. However, adaptive ecosystem management requires reliable long-term information from monitoring at multiple spatial scales. That is, adaptive management requires predicting an ecosystem's response to management and then measuring the system after the action (i.e., monitoring) to see if system outcomes conform to predictions. It is unclear however, what level of detail and degree of implementation is required in the alternatives for either "unit monitoring" or "broader-scale monitoring”. For example, section §219.12(4) of Alternative A states that “…the responsible official has the discretion to set the scope and scale of the unit monitoring program.” What is left to official discretion is unclear.

A second major source of uncertainty accompanies the process of assessing the viability of plant and animal species within the plan area. Viability assessments are inherently accompanied by uncertainty because the ecological processes of population persistence/extinction are inescapably probabilistic (Beissinger and McCullough 2002). To conduct a proper viability assessment requires the Forest Service to establish standards for persistence time and an acceptable level of risk (e.g., a 90% probability of persistence over 50 years). None of the alternatives include such standards.

Specific Comments

Below is a list of my comments/concerns applicable in varying degree to the plant and animal diversity provision in all five alternatives.

1. In the 2005 regulations, the Forest Service restricted its requirement to conserve biological diversity to a coarse-filter approach—that is, the remote monitoring of vegetation communities and their successional stages (also called cover types). However, the limitations of a coarse-filter approach to infer species’ distributions and status has been known for some time (Noon et al., 2005). A recent review of the degree to which coarse-filter models can be used to infer animal occurrence concluded that “…the observed error rates were high enough to call into question any management decisions based on these models” (Schlossberg and King 2009:609). These authors went on to state that “…[coarse-filter] models oversimplify how animals use habitats, and the dynamic nature of animal populations” (Schlossberg and King 2009:609). The coarse-filter approach is a necessary component of the assessment of biological diversity but it is not sufficient on its own—it needs to be accompanied by some degree of direct species assessment in order to validate the coarse-filter (Noon et al. 2009).
2. The term “habitat’ is used generically throughout the DEIS. When the term is used, it is my understanding that the authors had vegetation community types, and their successional stages (young, mature, old-growth), in mind. Habitat, of course, is a much

more complicated concept (see discussion below). Based on (1), habitat becomes synonymous with the coarse filter approach to conserving plant and animal diversity. As a predictive tool, a conservation strategy focused exclusively on maintaining the attributes of the coarse filter is unlikely to provide habitat for all species of management responsibility (Noon et al. 2009).

3. In practice, the biotic and abiotic elements and processes that characterize a species' habitat are often poorly known. What is usually better known is the relation between the occurrence of the species on the landscape and the vegetation structure and composition in the neighborhood of these locations. As a result, designation of vegetation community types and their successional stages has often been used as a surrogate for a species' habitat (i.e., the coarse filter). Defaulting to vegetation type as a descriptor of a species' habitat has a long history in ecology. It has been driven largely by pragmatism—vegetation is much easier to measure and characterize than prey resources or nest sites, for example. The practice continues because detailed vegetation maps exist for most parts of the country based on either extensive ground surveys or remotely sensed (e.g., satellite) imagery. However, it is important to keep in mind that vegetation is an assumed proxy for often more important, but more difficult-to-measure, resources. Some of the failure of vegetation-based habitat models to inform management and conservation may be due to breakdown of this assumption (Van Horne 2002). The important point is that the coarse filter approach has significant limitations and may not be sufficient for many species.
4. The environment, including habitat, generally seems to be considered as a static concept. I do not think that enough attention has been given in the DEIS to the dynamic nature of the environment and how this affects the achievement of management objectives. In general, the more dynamic the environment the more difficult it will be to achieve objectives and the greater the need for long-term monitoring data collected at both fine and coarse spatial scales. Effective management decisions require knowledge of the current state of the environment.
5. The focal species concept has sometimes been incorrectly equated to the management indicator species (MIS) concept as it appears in the 1982 regulations. Some MIS were assumed to reflect the status and trends of a large number of unmeasured species

(Landres et al., 1988). However, the concept that some species act as direct surrogates of others is untenable unless those species share similar population drivers (Cushman et al., 2010). The MIS approach, however, has merit in that it recognizes that the assessment of any complex system, such as an ecosystem, requires a surrogate-based approach. Focal species, in contrast, would commonly be selected on the basis of their functional role in ecosystems (e.g., species that serve keystone functions [Mills et al., 1993], act as engineers of ecological processes [Jones et al., 1994], indicate the action of key stressors [Caro and O'Doherty 1999], or strongly influence food webs via top-down control [Soule et al. 2005]). Noon et al. (2009) recently reviewed categories of focal species, methods to identify them, and how they may serve as surrogates for monitoring on federal public lands.

6. The relationship between "ecosystem diversity" and "species conservation" is not clearly articulated in the DEIS or in alternative A. To some extent, all alternatives treat ecosystems and species as if they were distinct concepts. A look at almost any ecosystem diagram in an ecology textbook will likely show a box-and-arrows diagram. Importantly, the boxes, with labels such as primary producers, decomposers, primary consumers, secondary consumers, etc., are occupied by species of plants, animals, and bacteria. That is, species are the process-engines within ecosystems responsible for the transfer of matter and energy among the boxes. The emphasis here is not on individual species names but on species' functional roles in ecosystems. An emphasis on species' functions is a connection that could be more fully exploited via expanding on the focal species concept in the alternatives.
7. Following on (6), thoughtful selection of focal species may be a way to link the two key components (ecosystems and species) of §219.9. Even though the focal species concept is generic, and not necessarily linked to a species' functional role in an ecosystem, many of the candidate categories of focal species (e.g., ecosystem engineers and strongly interacting species) are based on what species do in ecosystems.
8. The importance of maintaining a wide geographic distribution for a species' viability is not adequately emphasized. The concept of a viable population being "well distributed" throughout its range, as in the 1982 regulations, needs to be included in the current alternatives. One of the most important ways to increase a species' viability (decrease its

probability of extinction) is to maintain the species' populations widely distributed across the landscape. This effectively decouples the temporal dynamics of local populations of a species and thereby decreases the probability that all local populations will decline synchronously (den Boer 1981). Maintaining the distribution of widely distributed species may require close coordination among administrative units.

9. The importance of "trigger points" (Alternative D) or "signal points" (Alternative E) for species-level monitoring programs is recognized by only two of the alternatives. A monitoring program becomes little more than a time series of data with no feedback to management if trigger points are not established. (Noon 2003). That is, a monitoring program must establish a priori the magnitude of change in the monitoring state variable that would trigger a review of management practices.

Recommendation

I support Alternatives D and E because they give greater weight to the assessment of plant and animal diversity at the species level than the other alternatives (§219.9). The need to validate the coarse-filter component of the species diversity strategy cannot be over-emphasized. Components of Alternative E are particularly relevant to the NFMA diversity provision by increasing monitoring responsibilities and requiring estimation of the status and trend of focal species (§219.12). In its current form, Alternative A does not require the establishment of population trends for focal species. However, estimating temporal trends in some relevant state variables (e.g., abundance) is exactly what species-level monitoring is about. The relationship between "species of conservation concern" and "focal species" needs to be clarified in all alternatives. The best strategy would be based on validating coarse-filter management by assessing the viability of both species of conservation concern and focal species.

Additional Thoughts on Species Viability and Monitoring

Beginning with the 1982 regulations, two requirements for assessments of plant and animal (biological) diversity have had a particularly contentious history within the Forest Service. These are the requirements to 1) monitor and 2) conduct viability assessments at the species level (Noon et al. 2003). The Forest Service has attributed the difficulties they experienced in trying to fulfill these requirements to inadequate funding and to the perception that these requirements exceed the agency's capabilities. Both of these constraints were recognized by the Committee of Scientists report (COS 1999); the Committee partially addressed them by recommending that most monitoring and viability assessments be limited to a small set of focal species. The Committee's argument was simple—it was plainly unreasonable and infeasible to assess the status, trend, and viability of all species, even if limited to vertebrate species. Restricting assessment to a small (e.g., 10-20) set of species was meant to be pragmatic, to address the agency's requirements for conservation of biological diversity, to be within the capabilities of the agency, and to be based on the best available science (reviewed in Noon and Dale 2003).

Species-level monitoring and viability assessments are much more feasible today than they were at the time of the Committee of Scientists' report (COS 1999) and the 2000 NFMA regulations. There have been significant advancements in the last decade in survey design, statistical methods, the ability to estimate species distribution patterns based on presence/absence data, and in obtaining estimates of animal abundance based on individual animal identities. Further, it is important to note that scientists within the Agriculture and Interior Departments have made many of these advances. Thus, the capability and understanding of state-of-the-art scientific methods relevant to monitoring and viability analysis reside within the federal agencies responsible for species conservation.

A recent significant advance in wildlife monitoring is based on use of presence-absence data, which is relatively inexpensive to acquire, allows an exploitation of historical survey data, and can make use of recent advancements in genetic evaluation (e.g., MacKenzie et al. 2005). One variable estimated by occupancy models is the area occupied by a species, a measure of a species' spatial distribution. An example of its relevance to wildlife conservation is that the July 2005 issue of the *Journal of Wildlife Management* devoted a special section to the discussion and application of presence-absence sampling in wildlife monitoring (Vojta 2005) including an application to National Forest System lands (Manley et al. 2005). Temporal and spatial patterns in presence-absence monitoring data also allows inference to changes in animal abundance (MacKenzie and Nichols 2004), the single most important parameter that provides insights into likelihood of species persistence (Lande 1993).

Presence-absence monitoring can be based on real-time observation of a species at a survey site, or evidence that the species was at the survey location sometime in the recent past. One of the most significant advances in presence-absence monitoring takes advantage of the ability to confirm the presence of a species at a survey site based on its genetic signature (e.g., in hair or scat) (Waits 2004, Schwartz et al. 2006). If genetic markers are available, it is relatively straightforward to identify the sample by species on the basis of its DNA signature, and often to the individual level (Waits 2004). The ability to use indirect measures of presence for some species greatly increases monitoring efficiency and reduces survey costs.

These advances in survey methods (e.g., presence-absence models), detection techniques (e.g., genetic analysis), and changes in state variable from direct measures of demographic parameters (e.g., abundance, density, survival) to measures of area occupied have important applications to viability analyses. Traditional viability analyses have been based on estimates of demographic parameters including time series of abundance estimates, survival rates, and reproductive rates (Beissinger and McCullough 2002). Estimates of these parameters require extensive field surveys, frequent capture and marking of individual animals, are costly, and are available for only a small number of species. A consequence is that to require the Forest Service to conduct demographic viability analyses for all focal species is impractical.

In the planning rule and subsequent directives, it may be useful for the Forest Service to consider indirect methods of viability analysis that take advantage of advances in the monitoring methods and techniques discussed above. These methods use area occupied (estimated from presence-absence data) as a measure of a species' geographic distribution within the survey area (e.g., one or more adjacent nation forests). Area occupied, the viability state variable, serves as a surrogate measure or index of the species abundance in the survey area. Surrogacy is justified on the basis of the well-established positive relationship between a species' abundance and its geographic distribution (e.g., Brown 1984, Gaston 1996). Further justifications for this approach are that methods have been developed to estimate abundance from occupancy data (Royle and Nichols 2003, Stanley and Royle 2005) and that measures of abundance have consistently been shown to be highly correlated to occupancy rates (Gaston et al. 2000, Zuckerberg et al. 2009). Justification for use of the viability index method is also based on the significant positive relation between a species' abundance and its probability of persistence (Lande 1993, Lande et al. 2003).

The proposed index of viability based on presence-absence data will be accompanied by greater uncertainty about a species' true viability status than a demographically based analysis. This is inescapable. However, the index method may adequately address the agency's requirements for maintaining plant and animal diversity as well as including viability assessments for some subset of species.

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Reviewer # 2: Watershed Integrity

General remarks

Americans demand a great deal from their national forests. Forest plans are expected to protect and maintain watershed integrity (among other things), thereby providing sustained delivery of aquatic ecosystem services such as clean water, flood and drought modulation, water-based recreation, habitat for diverse biota, and scenic beauty. The key challenge that emerges from these increasing demands is making the U.S. Forest Service (USFS) planning rule broadly palatable across diverse (and often conflicting) stakeholders, as well as cost-effective. Of course, stakeholders differ greatly in their opinions regarding how to meet this challenge.

The five alternative planning rules are intended to meet the requirements of the Multiple-Use Sustained Yield Act and other laws that govern management of public lands. Meeting the demands of multiple (often conflicting) uses requires considerable compromise in the provision of any given use. Each alternative rule reflects a distinctive attempt to balance four primary tensions in managing national forest lands: 1) national consistency in forest plans versus local/regional customization; 2) authority of USFS officials versus that of other stakeholders (i.e., mutual trust); 3) primacy of selected resources (i.e., water, biodiversity) versus other forest resources and services; and 4) effectiveness versus monetary cost.

I generally was satisfied with the discussion of the scientific underpinnings of alternatives, especially for Alternative A. Discussions in the DEIS included solid syntheses of current ecological science, impact analysis, and restoration approaches. A minor shortcoming was the sparse discussion of invasive aquatic species.

An important discussion missing from the DEIS is how management actions are selected (from a presumed long list of possible actions) and how the adoption of a given alternative might influence the selection or implementation of such actions. This omission is glaring in the conceptual model for planning that includes the components “monitor”, “assess”, and “revise”; without “action” in that model, there is little real need for the monitoring cycle. Moreover, until differential actions are implemented, all plans are equally effective (or ineffective). Plan assessments determine which actions are *appropriate* but the reader is given little insight into how land management under each scenario might actually proceed.

Alternative A

This alternative adopts an integrative, landscape perspective and incorporates many significant improvements over Alternative B (status quo) regarding conservation of biodiversity and the capacity to provide aquatic ecosystem services. It also does a much better job incorporating current scientific concepts and approaches than Alternative B.

This is my 2nd overall choice of given alternatives.

Alternative C

This alternative promotes significantly less planning than Alternative A and limits the ability of USFS to meet societal demands on national forest lands.

This is my 5th overall choice of given alternatives.

Alternative D

The scientific rationale for this alternative is very similar to that of Alternative A but this alternative requires more-explicit assessment and monitoring of watersheds and landscapes. It appears to provide significantly more protection for watershed and riparian conditions, as well as water quality, relative to Alternative B. The additional required monitoring (relative to A) of focal species would be important for biodiversity concerns but not for ecosystem service concerns. One of the biggest potential gains from this alternative is an enhanced ability to assess efficacy of the forest plan in maintaining biodiversity.

This alternative assumes that roads and riparian areas are uniformly very important across national forests, and makes them focal points of monitoring and assessment. It also provides a strong rationale for how to prioritize road decommissioning. However, this alternative does not make a compelling case for the presumed ubiquitous need to restore aquatic ecosystem elements on national forests.

A key issue for this alternative is whether the additional \$13.5M (13% relative to Alternative A) is cost-effective. Some of the additional requirements may not be cost-effective. For example, the required watershed-scale assessments may be useful but it is not clear this spatial resolution of analysis is justifiable, given the uncertainty in existing climate-change models. Also, although the requirement for more coordination is likely to be important in rapidly changing landscapes (as projected for the next few decades), much of the additional required coordination with stakeholders seems likely to occur in Alternative A anyway.

This is my 1st overall choice of given alternatives (but see discussion of Alternative D1).

Preferred Alternative D1

Although Alternative D has several strengths over Alternative A regarding its provision of resource conservation, Alternative D also carries significant political risks. First, Alternative D is vulnerable to the same problem exhibited by the 2000 rule, whose planning process has never been used because it was deemed too costly and complex. Second, Alternative D may place too much emphasis on ecological sustainability (relative to economic and social sustainability) to be politically palatable to a broad consensus of stakeholders. Third, the intensive monitoring and assessment required under Alternative D may exceed available budgets. Finally, a key uncertainty relative to choosing Alternative D is whether the incremental increases in explicit prescriptions for assessment, analysis, monitoring, and coordination will actually produce substantive improvements in land management. Most of the added explicitness is already implicit in Alternative A.

In an effort to reduce these risks and retain the main conservation benefits of Alternative D, I suggest creating Alternative D1, which eliminates some of the differences between alternatives A and D, and would presumably reduce the cost of Alternative D. Appendix F of the DEIS lists side-by-side differences in text between alternatives A and D. Some of these differences seem more important than others in terms of achieving management objectives without increasing costs excessively. As a way to enhance the conservation cost-effectiveness of Alternative D, I compiled below the verbatim text from Appendix F that I think should be retained in the creation of Alternative D1; other differential text would be omitted.

(ii) develop strategies to address the impacts of global climate change on plant and animal communities;

(7) Identify key watersheds that are areas of highest quality habitat for native fish,

(2) ecological conditions required to support viable populations of native species and desired non-native species within the planning area; and

(3) current and likely future viability of focal species within the planning area.

(v) Key watersheds across the planning unit in order to establish a network that can serve as anchor points for the protection, maintenance, and restoration of broad scale processes and recovery of broadly distributed species; and—

(vi) Spatial connectivity within or between watersheds, including lateral, longitudinal, and drainage network connections between floodplains, wetlands, upslope areas, headwater tributaries, and intact habitat refugia.

(i) Establishment of Riparian Conservation Areas based on the best available science. Until these riparian conservation areas are established, the minimum standard buffer for riparian conservation areas shall be no less than 100 feet on each side of the stream at bank-full flow, unless the stream has an intermittently or potentially shifting channel course, in which case the default buffer must start from the edge of the 200-year channel migration zone.

(ii)Protection, maintenance, and restoration of Riparian Conservation areas, such that—

(4) *Watershed standards and guidelines.* Each plan must include standards and guidelines for—

(i) Biological and biophysical connectivity of key watersheds across the planning unit.

(ii) Road densities in key watersheds to achieve sediment reduction, minimized alteration of surface and subsurface flows, and connectivity of aquatic and riparian habitat.

(iii) Maintenance and restoration of lakes, streams, wetlands, public water supplies, source water protection areas, groundwater, other bodies of water, instream flows, and thermal refugia, and protection of these resources from detrimental changes in quantity (subject to existing rights) and quality, including temperature, blockages of water courses, deposits of sediments

(v) Sustaining soil productivity and preventing soil erosion and sedimentation.

(vi) Road removal and remediation in riparian conservation areas and key watersheds as the top restoration priority

(ii) The status and trends of ecological conditions within the planning area, including critical values for ecological conditions and focal species that trigger reviews of planning and management decisions to achieve compliance with 219.9(a);

Population surveys, of focal species using methods to assess the degree to which ecological conditions within the planning area are supporting a diversity of plant and animal communities within the planning area, such as presence/absence occupancy

Focal species. Species selected, based on the best available science, for assessment and monitoring because their population status and trends are likely to be responsive to changes in eco1ogica1 conditions, and provide reliable and meaningful information regarding the effectiveness of planning and management decisions in maintaining a diversity of plant and animal communities within the planning area. A species-at-risk also may be selected as a focal species.

Species-at-risk. Federally listed endangered, threatened, candidate, and proposed species and other species for which loss of viability, including reduction in distribution or abundance, is a concern within the plan area. Other species-at-risk may include sensitive species and state listed species.

Viability Analysis. The process of evaluating the current state and likely future status of a species, based on information on trends in its abundance, density, or geographic distribution.

Viable Population. A population that has a high likelihood of persisting well distributed throughout its range within a planning area for a period of at least 50 years into the future, based on the best available scientific information on its ecological conditions, abundance, distribution, reproduction, and survival rates.

Reviewer # 3: Climate Change Adaptation

It is always refreshing to meet a document that attempts to explicitly include the reality of climate change in a natural resource planning or management mechanism. To create strategies and guidance for the whole of the National Forest Service is something long overdue given the current state of affairs in the world around us.

There are some key aspects to any effort that attempts to incorporate the reality of climate change. It can be considered a step-by-step process for simplicity sake.

1. Create clarity around the goal. In general, an agency or organization should not change their goal to incorporate climate change; rather, they should create clarity around their goal, evaluate its vulnerability to climate change and then determine what actions can be taken to reduce this vulnerability of their goal and their existing strategies and actions, then incorporate these "resilience-building" actions. It is of course possible that a goal would be so vulnerable or unlikely to be achieved that it would be changed; however, given human values and governing mechanisms this will rarely be the case.
2. Consider the range of actions one can take. There are three categories of adaptation: resistance (trying to stop change or buffer against it), resilience (trying to support a system to weather the effects of change yet maintain function), or response (changing course). Think of combinations that change over space and time.

3. Incorporate various strategy components, including protecting adequate and appropriate space, reducing non-climate stressors, managing for uncertainty, reducing local climate change, and reducing global climate change (Hansen and Hoffman 2011).
4. Implement and monitor these approaches in order to address climate change in the iterative manner that is necessary for the condition of chronic change.

The new USFS Rule and DEIS attempt to incorporate and evaluate this philosophy, but it seems to do it with a lack of clarity, which will be likely to result in ineffective implementation.

The underlying three-part "learning and planning cycle" could be ideal for climate change; however, it seems to rest on a step to "assess condition and stressors" that is not explicitly anticipatory. The problem with climate change is that if we only look at contemporary manifestations you risk making decisions that do not take into account the likely futures, and these decisions might actually preclude good future management options. So in this part of the process, it would behoove the USFS to clarify 1) the need for present and anticipated assessment, 2) the timeframe for review: 10, 25, 50, 100 years, 3) creation of explicit temporal guidance to match the spatial guidance the FS has for management decisions.

There is a preamble in the document on whether or not to include climate change in the Rule. It is not clear what to make of these perspectives. The argument that there is too much uncertainty should preclude us from having management actions around anything having to do with natural systems, forget about economic systems. The argument that you can include climate change without explicitly considering it is also a bit wild to imagine the effective implementation of.

The DEIS component on climate change is thin. Comments for each alternative follow:

Alternative A:
This discusses a "responsive" framework. "Responsive" may not be the most efficacious, feasible, cost effective, or palatable means of addressing the threat to national forests and their function from climate change. Anticipatory or preparatory actions should also be included so you don't lose options for action that response may entail, as well as increasing your likelihood of

success. There is not much that can be done well to deal with the effects of climate change after they come to pass. For example, once sea levels have risen it is hard to build floodplains or even sea walls to address the problems caused the risen seas.

Step One of this framework still seems to focus only on past and present condition, leaving out likely future conditions that are in fact what you "plan" for. This step needs to develop a way to think beyond the status quo. There is one sentence to give hope that says the assessment would "understand and assess existing and potential future conditions and stressors in order to inform and develop required plan components…" However, this in the DEIS, not in the directions provided in the framework. This should be made more explicit.

This Alternative, and those parts of the Plan that include climate, seem to rely a bit too heavily on the concept of "resilience." It may be substantially misguided if we are trying to confer resilience based on historic conditions and this knowledge may be deceptive in achieving future resilience. We will need to be cognizant of this in decision making. This worry comes further to bear when phrases such as "maintenance or restoration of the structure" are used, as these indicate this retrospective or status quo approach that will get us into trouble.

Another term used in this document that is a challenge in the face of climate change is "sustainable." What does this term mean given the changes afoot due to a changing climate and the resulting changes in ecosystem dynamics, coupled with synergistic effects of other anthropogenic stresses?

This alternative also talks about using the "best scientific information." Phrases like this often make me nervous. Climate change is wrought with conflict over what is the "best" information, yet we don't have this kind of requirement on other management decisions. It would also seem to preclude traditional knowledge, professional knowledge, societal will, and management constraints.

The plan is also considered to be amendable "in response to changes influenced by climate change." Again this seems awfully retrospective for a problem that will require pro-active approaches. I worry that the USFS will be backing itself into a management corner. It is also not clear that responses are in any way necessary or mandated by the plan, rather it just provides opportunities.

Oddly, this section also discusses carbon storage. Since carbon protection is not a goal of the USFS it seems out of place. Additionally, the carbon stored in biological systems is not limited to above-ground vegetation. There are heaps of carbon in soils and roots, and this carbon is affected by above-ground management actions taken the USFS, including timber harvest and water extraction.

Several of the evaluations do not include enough information to determine how they made their evaluation:

Alternative B:
It is not at all clear why this alternative would be "less information related to climate change for decisionmaking than its alternatives A, D and E. "

Alternative C:
While there is no "planning framework" in this model, there are many ways that good management decisions can be made in the face of climate change without assessment and monitoring that may itself be flawed for determining implications of climate change. For example, given the crudeness of most of our management approaches, having specialized data might be less valuable than inherent knowledge of managers and their sense of change. So it is not clear how this perceived lack of information would preclude or inhibit actions that can take into account climate change.

Alternative D
Billed as having greater opportunity to detect and respond to threats, but not clear how this would play out.

Alternative E

Unclear if "greater recognitions of uncertainties" is viewed as beneficial or not. I'm also uncertain why it is true of this alternative.

The DEIS seems a little off the mark in some of its interpretations of the Rule, and the Rule seems a little off the mark on implementing some of the USDA strategic plan, which indicates that it is highly likely that the Rule could be misimplemented.

The goal of the USDA strategic plan includes "ensuring our national forests and private working lands are conserved, restored, and made more resilient to climate change, while enhancing our water resources." This is quite well worded, save the worry about restoration that is at odds with resilience. This implies anticipatory management not just response as expressed in the Rule and DEIS.

[Other goals of the strategic plan are bit more worrying as they assume effectiveness without the implicit reality of climate change, such as the food security goal which is most certainly at risk from climate change.]

Interestingly, the Forest Service Strategic Plan does not include the anticipatory management approach implied in the USDA goals. It focuses on maintaining the status quo, an almost certainly impossible task given the change ahead. With goals like "restore", "sustain", "conserve" and "maintain" you get a picture of grasping at the past rather than planning for the future.

Some sections of the document beyond the "climate change" section should explicitly include the reality of climate change, yet I fear the Service is trying to compartmentalize the issue, which will not have good outcomes. Examples:

- Ecosystem Restoration: While they do reflect on past state vs. better function, there is no explicit consideration of temporal scale and the continually shifting frame that restoration activities must face from heretofore.

- Watershed Protection: There is a great opportunity for watershed protection to become a key function of the FW given the reality of climate change. This will have broad reaching societal implications that we can only begin to imagine.

Issues at large:

1) Science is very clearly outlined, however developing management strategies that include the reality of climate change will also require creative, innovative new thinking that is not just about science. How will the process integrate philosophy and creativity?
2) Information sharing should not be a one-way process with the public. The creativity and innovation to meet these challenges may not come from within the Service, or even from the wise halls of research. You need to develop mechanisms for learning from the public, not just letting them know what you plan to do and perhaps comment on it. Public here includes tribes and native peoples.
3) If a plan is meant to last 15 years it is absolutely necessary to include climate change in the management decisions being made on that timeline. Failure to do so will mean bad plans are created and inadequate management decisions are made.

Further details:

Alternative A: It is hard to see how climate change is explicitly being considered in the rule itself. It is set out as key in the Planning Framework, but after that point it is not clearly addressed other than as:

1) A possible issue around sustainability, but as sustainability is not clearly defined there is no way of knowing what would need to be done to incorporate climate change into sustainability;
2) Something to monitor for.

This doesn't do a compelling or effective job of integrating climate change into the Rule.

Alternative B: As the present Rule, which this is, has no climate change contingency, this provides an inadequate tool to protect our forest related resources from the risks of climate change.

Alternative C: Appears to have no mention of climate change.

Alternative D: Mention of climate change is bit more pervasive. It is discussed under:

- Species viability: "develop strategies to address the impacts of global climate change on plant and animal communities;"
- Assessments: "Prepare watershed-scale assessments including an assessment of climate change vulnerability, using the best available science, to provide information on the ecological status – aquatic, riparian, and terrestrial – of watersheds within the planning unit. Managers will use information gathered during the watershed assessment to refine default Conservation Area boundaries and develop monitoring programs," and " To provide the basis for complying with 219.9(a) the Secretary shall utilize the best available science to determine:(1) current and historic ecological conditions and trends, including the effects of global climate change;"

Alternative E: Mention of Climate Change occurs in:

- (ii) status of key ecological conditions affecting species of conservation concern and ecosystem diversity within each plan area focusing on threats and stressors that may affect ecological sustainability such as management activities, invasive species, or climate change;

Alternative F: Appears to have no mention of climate change.

Alternative G: Mention of Climate Change occurs in:

Assessments: "(1) Identify existing conditions, past and projected trends, and possible scenarios at a scale appropriate to the roles and contributions of the planning unit to the

larger geographic area, to develop plan components, as required by:
(i) § 219.7, plan development or plan revision;
(ii) § 219.8, sustainability including watershed elements; ecological variables such as structure, composition, processes, and connectivity that are needed to sustain healthy and resilient terrestrial and aquatic ecosystems; provision of ecosystem services including multiple uses such as recreation; contribution to local, regional and National social and economic systems; renewal and recovery of systems from disturbances; risks, stressors, and affects of invasive species; public safety; risks and uncertainties associated with climate change;"
(iii) § 219.9, diversity of plant and animal communities including status of plant and animal species, their communities; their capacity for resiliency; and ability to move across landscapes. For example, to comply with § 219.9, the assessment for a plan revision should consider the existing status, trends, and future possibilities of key ecological conditions affecting ecosystem diversity and species of conservation concern within the plan area focusing on threats and stressors that may affect ecological sustainability, such as development pressure, invasive species, or climate change;

Reviewer # 4: Climate Change Mitigation (especially carbon sequestration).

The DEIS correctly describes the importance of understanding the impacts of management activities on the carbon balance of forests. Many management activities in forests are likely to have major impacts on the ability of forests and the entire forest sector (forest and wood products) to store carbon. This includes everything from traditional timber harvest to biodiversity-related activities and ecosystem restoration as well as climate mitigation and adaptation-related activities. The document even describes the major carbon pools related to carbon sequestration in forests: live, dead, soil, and wood products. Unfortunately, in the implementation of planning only the live carbon will be considered in each of the Alternatives except Alternative C , which was created in 1982 when carbon sequestration in forests was not an issue. Despite the mention of considering forest carbon in all the other Alternatives, considering only the live carbon is *completely unacceptable* and will result in numerous challenges to planning that will be impossible to defend. It is hard to imagine the rationale behind this decision, although it may have been attempt to simplify the forest carbon system to make it more understandable. However, as outlined below this creates a system that does not exist.

A major problem is related to the idea that the entire planning process is based on use of the best science available. Considering only live carbon is *not* use of the best science available. That would not have been true in 1982 let alone 2011. Considering only the live carbon would build in out-dated and misleading science into the planning process.

Since no rationale for the proposal to only consider live carbon is offered, I will offer some potential rationales and point out the flaws in each.

In terms of carbon stores, it could be assumed that just considering the live pool will lead to an underestimate that could be expanded up to the total store using constants. This would be true if the other pools were well correlated with the live stores. In the case of above- versus belowground live carbon this assumption might work. But for the dead (dead wood, leaves, roots), soil, and to some extent the wood products this correlation is very weak and may even change sign depending on the type and interval of disturbance or harvest. Thus, there would no way to make any estimate of the total effect on carbon stores if only the live carbon is considered. And this problem does not disappear if either the dead, soil, or wood products are assumed to be constant.

The problem created by this assumption is actually much worse than indicated above because the flows of carbon in and out of these pools offset each other. That is, adding in the missing pools does not make the carbon balance more positive as it does with stores. When only the live is considered, the offsetting flows in the dead, soil, and wood products are not considered. For example, if just the live is considered, then it is possible to calculate an optimum harvest interval to maintain carbon removal, much like the optimal harvest rotation to maximize harvest volume. However, no such optimal harvest interval exists because gains in live carbon are offset by losses in dead and soil carbon. This means that, regardless of harvest interval or intensity, if a harvest system is repeated over and over there is no net gain in carbon stores and the average flow is zero. The "simplification" of just considering live carbon creates a system that behaves in ways that do not actually exist.

Another possible rationale, other than simplifying the system, might be that Forest Service personnel are only trained to consider live tree volume and since it is relatively straightforward to convert live volume to live carbon this would require little additional training. This is not convincing and essentially says there will be no improvements in Forest Service training or capability. If this is the case, then it builds incompetence into the planning system. Given this structural flaw in forest carbon competence, I would have little faith Forest Service personnel could manage carbon on Federal lands. Therefore any statements concerning the impact of plans would not be viewed as either reliable or credible. It is therefore clear that Forest Service training and capability in carbon management has to improve.

It could also be argued that the Forest Service does not have data for any pool except live carbon. While it is likely true that the live pool is the best understood and quantified, if there are not data on dead or soil pools, then the credibility of wildlife, fire fuel, and sustainability aspects of planning is questionable. Without knowledge of standing dead trees, how would it be possible to assess the impacts of actions on cavity nesting birds? Without knowledge of dead and downed wood, how would it be possible to assess fire severity or smoke management? While soil carbon is hard to quantify, since it is related to soil organic matter and soil organic matter is related to site productivity, how would it be possible to assess the impacts of management actions on site productivity without any information on potential changes in soil carbon? The only pool to which Forest Service personnel would not have access to data would involve wood products. However, to justify harvests it would be important to specify how harvested material will be used. This information could be used to roughly estimate the impact of management actions on stores in wood products.

To be effective and credible, Forest Service planning needs to consider all the relevant pools of carbon related to forests including the stores of carbon in live, dead, soil, and wood products. In addition, offsets such as biofuels and substitution of wood for other, more energy-intensive materials should be included with the caveat that these offsets be treated in a realistic manner. For example, it is not credible to assume that all biofuel harvests are automatically carbon neutral. The neutrality of biofuels and in fact any proposed action needs to be based on how the action compares to the existing system of management. In the case of substitution offsets, one cannot ignore addititonality (the degree the action increases carbon stores in buildings) or permanence (the idea that building stores have to be maintained). Most of the current substitution offset estimates assume either carbon stores in buildings increase forever or that building carbon stores always start at zero, or that non-wood materials are the preferred over wood. None of these assumptions is actually true and as a result substitution offsets have been grossly overestimated.

While not part of the planning process, if the planning process is to be taken seriously, the Forest Service needs to invest in their personnel so that they can knowledgably manage carbon. There also needs to be investments in tools that will inform policy decisions. These need to move beyond estimating live tree volume to all the pools of carbon relevant to understanding the carbon dynamics of forests.

Monitoring

I am concerned about the vagueness of the plans for monitoring in all the Alternatives except C, which despite being outdated at least provides a detailed consideration of monitoring. First, it is not clear the level to which monitoring will be undertaken in any of the other alternatives. Monitoring can consider whether plans are implemented, the effectiveness of the actions, or the underlying assumptions of the proposed action (validation). While I understand that funds rarely exist for validation monitoring, without support for effectiveness monitoring there will be no information to feedback to shape future management actions. Hence there could not be any meaningful adaptive management.

I am also concerned about language that seems to indicate that the unit managers may decide to not implement monitoring. This not only would lead to uneven levels of assessment, but also would remove any impetus to demonstrate how plans change over time.

Reviewer # 5: Ecosystem Restoration and Resilience to Climate Change

Ecological restoration has been recognized as a legitimate and necessary management objective on the national forests for at least two decades. In the historic "June 4th memo" (Robertson 1992) committing the Forest Service to the use of an ecosystem approach to achieve the multiple-use management of the National Forests and Grasslands, Chief Dale Robertson called on the agency to "'Take Care of the Land' by protecting or restoring the integrity of its soils, air, waters, biological diversity, and ecological processes." Chapter 2020 of the Forest Service Manual details the many laws from which the Forest Service derives its authority and duty to practice ecological restoration.

Despite its firm place in contemporary management of the national forests, ecological restoration was not considered in the 1982 regulation implementing the National Forest Management Act, and the Proposed Rule seeks to rectify the situation and elevate restoration to its appropriate place in law. Indeed, as Secretary Vilsack notes (DEIS, inside cover):

> The Forest Service planning process provides an important venue to integrate forest restoration, climate resilience, watershed protection, wildlife conservation, the need for vibrant local economies, and the collaboration necessary to manage our national forests. Our best opportunity to accomplish this is in the developing of a new forest planning rule for our national forests.

Accordingly, the Purpose and Need for Action section of the EIS (DEIS, p. 7) identifies the "need for a planning rule that protects, reconnects, and restores national forests and grasslands for the benefit of human communities and natural resources" as its primary purpose.

Definitions

To facilitate understanding, the Proposed Rule (FR, p. 8524) defines restoration as:

> The process of assisting the recovery of resilience and the capacity of a system to adapt to change if the environment where the system exists has been degraded, damaged, or

destroyed. Ecological restoration focuses on reestablishing ecosystem functions by modifying or managing the composition, structure, arrangement, and processes necessary to make terrestrial and aquatic ecosystems sustainable, and resilient under current and future conditions.

Restoration is further described as an aspect of *conservation*, which is defined (FR, p. 8523) as "The protection, preservation, management, or restoration of natural environments and ecological communities." Thus, restoration is concerned with reestablishing the function of natural ecosystems. Much of the Proposed Rule, especially sections 219.8 on Sustainability and 219.9 on Diversity of plant and animal communities, describes the planning requirements necessary to sustain the composition, structure, and processes of natural ecosystems that give rise to function.

Unfortunately, the Proposed Rule does not take the next step to define what is meant by "natural environments and ecological communities." Naturalness, which was once thought to be sufficiently meaningful to guide conservation, has recently been shown to carry multiple, sometimes conflicting, meanings, necessitating careful definition in practice (Cole and Yung 2010, Hobbs et al. 2010). As explained by Aplet and Cole (2010), natural ecosystems may be described in three distinct ways: 1) as free of intentional human control (i.e., "untrammeled"); 2) as unaffected by human activity (whether intentional or unintentional); or 3) as possessing the characteristics of "primitive" or "primeval" ecosystems (a quality known as "historical fidelity"). As scientific understanding has grown, it has become clear that these meanings can sometimes be in conflict, as when historical ecosystems depended on intentional human action (e.g. aboriginal fire use), or when untrammeled conditions degrade through the invasion of non-indigenous species. Thus, it is important for the implementation of policy that managers understand what is meant in the Rule by "natural environment and ecological communities."

To help illustrate this concept, Aplet and Cole (2010) present a figure that represents ecosystems as occupying the two-dimensional space created by untrammeled conditions on one axis and ecological quality on the other. Ecosystems may possess any combination of these two qualities, from highly controlled and altered (e.g., the built environment of the city) to largely uncontrolled and intact relative to historical conditions (e.g. the Arctic National Wildlife Refuge). Ecosystems may also be ecologically degraded but largely left to function autonomously (e.g., a vacant lot or exotic grassland), or they may be highly controlled for the purpose of rebuilding a lost or currently degraded historical ecosystem (e.g. the restored "Curtis Prairie" within the University of Wisconsin Arboretum). It follows, then, that management may be directed toward any of these combinations, as well. An ecosystem may be freed from human control and return to a historically bounded, dynamic behavior (a condition described as within the "historical range of variability") through the process of "recovery." Alternatively, an untrammeled system may "drift" away from its historical condition, as pollution, invasive species, or lack of aboriginal fire alters the ecosystem, or, if that alteration occurs intentionally, it is said to go through "transformation." Only when an ecosystem is brought under intentional control for the purpose of increasing its historical fidelity do Aplet and Cole apply the term "restoration."

The definition of restoration in the Proposed Rule reflects this understanding but could be made clearer. It stresses "reestablishing ecosystem functions," thereby rooting itself in historical ecological condition. This definition is a significant improvement on that in Chapter 2020 of the Forest Service Manual, which focuses only on "establishing" the conditions to make ecosystems "sustainable, resilient, and healthy." Both definitions refer to "recovery of resilience," indicating that a "damaged, degraded, or destroyed" ecosystem is one that has lost resilience relative to historical conditions, but the new definition makes it clear that recovery of resilience is to be through reestablishing historical ecosystem function. Thus, the definition in the Proposed Rule establishes a distinct meaning for restoration as a means of conserving "natural environments and ecological communities," as called for in Cole and Yung (2010) and Hobbs et al. (2010), but this meaning must be teased out by the reader; it should be made explicit.

Restoration and Resilience to Climate Change

Clarification of the meaning of restoration implied by the phrase "reestablishing ecosystem functions" would be helpful, but it also plays directly into a popular criticism of managing for historical conditions: that the future will be so unlike the past that historical conditions are either irrelevant to the future or set the system up for catastrophic change (Stephenson et al. 2010). It has been argued that instead of managing for historical conditions, managers should seek "resilient" systems that retain valued aspects of ecosystems, including ecosystem services, and resist a fundamental loss of character. Elements of this thinking are reflected in the Proposed Rule's definition, where restoration is described as "assisting the recovery of resilience," which is further defined as "the capacity of a system to absorb disturbance and reorganize while undergoing change so as to *still retain essentially the same function, structure, identity, and feedbacks*" (emphasis added). Thus, managing for resilience implies managing for some, but not necessarily all, valued elements of ecosystems. As Zavaleta and Chapin (2010) note, "Defining what about a system should be resilient could fall to the public, scientists, managers, or policymakers; deciding who decides is not trivial." Clearly, the intent behind managing for resilience is to manage for something other than historical conditions; the problem is that once the historical range of variability has been abandoned as a management goal, it is not at all clear what should be emphasized in terms of ecosystem composition, structure, and processes.

In its sections on Sustainability and Diversity of plant and animal communities (FR p. 8518), the Proposed Rule attempts to provide one plausible set of elements to emphasize when managing for resilience. There, a strategy is laid out that combines a "coarse filter" of ecosystem conservation with a "fine filter" of species conservation. The valued elements of the coarse filter are the "structure, function, composition, and connectivity of healthy and resilient terrestrial and aquatic ecosystems and watersheds," especially aquatic elements (lakes, streams, etc.), terrestrial habitat types, public water supplies, soils and soil productivity, and riparian areas. Notably, the "composition" described in the coarse filter does not include individual species, so the strategy includes a fine filter of providing conditions to 1) contribute to the recovery of listed species, 2) conserve candidate species, and 3) "contribute to the extent practicable to maintaining a viable population" of other species of conservation concern. By requiring that plans include elements to conserve both ecosystem elements and species, the Rule identifies the essential elements of the system to provide resilience.

The set of elements identified in Sections 219.8 and 219.9 help define *what* to manage for when managing for resilience, but it does not help to identify *how*. Ecosystem management, which stresses the maintenance of historical ecosystem composition and dynamics through the maintenance of characteristic patterns and processes of disturbance, arose in response to the failure of conventional management systems to sustain particular elements of ecosystems, notably fish, spotted owls, and red-cockaded woodpeckers. It was based on the premise, as described in the Proposed Rule's section-by-section explanation (FR p. 8492), that "native species evolved and adapted within the limits established by natural landforms, vegetation, and disturbance patterns prior to extensive human alteration. Maintaining or restoring the ecological conditions similar to those under which native species have evolved therefore offers the best assurance against losses of biological diversity and maintains habitats for the vast majority of species in an area…" In other words, maintaining species requires maintaining historical ecosystems. The Federal Register notice has completed a loop of circular reasoning by arguing that conditions that should be emphasized to avoid managing for historical conditions are, in fact, historical conditions.

To add further to the confusion, the Federal Register notice reframes the meaning of "restoration" away from the focus on historical conditions, as used by Aplet and Cole (2010), toward a meaning more consistent with "transformation," or the intentional creation of conditions outside of the historical range of variability:

> Refocusing the use of the term ''restoration'' to focus on recovery of resiliency and ecosystem functions (instead of historical reference points) offers greater flexibility to develop plan components (*e.g.,* desired conditions) that provide more feasible and adaptable direction for addressing damaged ecosystems; (FR, p. 8509)

Such a position is consistent with the aforementioned critique of the historical model but is inconsistent with the logic of the coarse filter. How can the agency simultaneously achieve the creation of both historical and novel conditions through national forest management? – only by pursuing these two goals on separate parts of the landscape, a proposition considered in the following section.

Zoning the Forest for Learning: Adaptation in the Face of Climate Change

As mentioned, Aplet and Cole (2010) characterize four potential "directions" of management (recovery, drift, transformation, and restoration) depending on the degree of historical fidelity and human intent involved in each. In that same chapter, they consider the implications of global change for the future of each and conclude that factors like climate change, species invasions, and atmospheric pollution are so pervasive and powerful that it is unrealistic to expect a degraded ecosystem to recover to historical conditions if freed from human control over the long term. The ideal of wilderness management – the perpetuation of whole historical ecosystems through passive "untrammeling," is no longer tenable. The only management options remaining are 1) to *accept change* by allowing ecosystems to "drift" into new conditions, 2) to *guide change* by actively transforming systems into forms capable of sustaining their most valued aspects and ecosystem services, and 3) to *resist change* and try to retain the composition, structure, and processes of complete, historical ecosystems through the process of "restoration."

At the same time that these realities are presenting themselves, other authors are arguing that the uncertainties associated with climate change require that a range of alternative approaches be tried to conserve the values and services we expect from ecosystems. For example, the IPCC (2007) concluded, "A portfolio of adaptation and mitigation measures can diminish the risks associated with climate change," a judgment echoed by Millar et al. (2007), who stated, "Managing in the face of uncertainty will require a portfolio of approaches, including short-term and long-term strategies, that focus on enhancing ecosystem resistance and resilience…as climates and environments continue to shift." Managers will have to try different approaches in different places, some with an emphasis on restoration, some on transformative activities, and some places we simply leave alone and observe. These three management options encompass many of the climate adaptation strategies that have been described in the literature. Strategies of reserve establishment, protection of old growth and corridors, and monitoring align well with the option to accept change. Reestablishing fire and flood regimes and reconnecting flood plains are familiar restoration actions, whereas more aggressive activities, such as assisted migration and the establishment of "neo-native forests," (Millar et al. 2007) fit in the vein of transformation. The problem is that we just don't know which of these options will best serve adaptation. Some are well-established, proven conservation methods, while others entail significant risk, due to the lack of a track record, but may nevertheless be worth testing (Lawler et al. 2010).

The new Planning Rule can facilitate the adoption of this new approach by explicitly requiring the designation of management zones dedicated to these three purposes. Each planning unit should allocate lands (ideally watersheds) to reserve, restoration, and transformation categories.

Watersheds should be connected, to the maximum extent feasible, across climate-relevant environmental gradients of elevation and latitude to facilitate movement and range shifts in response to climate change. Plans should connect congressionally designated wilderness, often occurring at the highest elevations of planning areas, with lower-elevation watersheds through the designation of research natural areas and other management areas where change is to be observed without manipulation. Such reserves are not guaranteed to sustain all valued elements and services of ecosystems, but their historical "track record" is excellent, and they ought to be part of any strategy to sustain ecosystems in the face of climate change (Landres 2010).

Designation of the other two classes of land should be handled in the same way. Parks, monuments, wildlife refuges, and other land classes that are managed to preserve valued elements of historical ecosystems should be connected, to the maximum extent feasible, across gradients of elevation and latitude by allocating watersheds of the national forests to a similar purpose. Such allocation of a "restoration zone" would make explicit which parts of any planning unit will be dedicated to restoration of historical conditions. This zone would be dedicated to testing the premise that "maintaining or restoring the ecological condition similar to those under which native species have evolved therefore offers the best assurance against losses of biological diversity" (FR, p. 8492).

The third class, the "transformation zone," would consist of the remainder of the planning unit, also set up to maximally connect across environmental gradients. Here, the desired future condition would be less constrained to achieve historical conditions, allowing the testing of new approaches to achieving resilience in the face of climate change. In all three of these land classes, the requirements for sustainability and diversity described in Sections 219.8 and 219.9 would apply; only the means of achieving them would be different.

The primary benefit of this "three zone" management system is to explicitly address the uncertainty that attends climate change. It is not currently clear what the best approach will be to sustainability in the face of climate change. Some have argued that the pressure of climate change should lead to "designating new protected areas and undertaking low-level habitat management to reinforce species' intrinsic dispersal and migration mechanisms" (Dawson et al.

2011), while others have suggested that "[a]ccepting that the future will be different from both the past and the present forces us to manage forests in new ways" (Millar et al. 2007). As a third alternative, restoration addresses Leopold's still-relevant "first rule of intelligent tinkering:" to keep all the parts. Ultimately, climate change will operate on what exists, and it makes sense to carry into the future a "portfolio of approaches," where some areas are managed creatively and deliberately to promote certain ecosystem services and values, some are managed to conserve as much of our natural heritage as possible, and the rest is left for Nature to change on her own time, in case we're wrong elsewhere.

Currently, the Proposed Rule requires the identification only of "watershed(s) that are a priority for maintenance or restoration" (Sec 219.7(e)(1)(i)). Alternatively, Section 219.8(a) requires plans to include components to "maintain, protect, and restore" certain ecosystem elements and riparian areas. The adoption and application of the tripartite "maintain, protect, and restore" language to Section 219.7(e) could facilitate the allocation of watersheds recommended above. Language should be crafted to require that all watersheds be allocated to one of three management areas to *maintain* high levels of ecosystem services and values through creative, experimental management; to *protect* those values through reserve-style management, or to *restore* historical ecosystem conditions. Definitions of maintenance, protection, and restoration should be included to clarify their application to these three purposes.

Restoration and Resilience

As mentioned, one of the primary criticisms of managing for historical conditions is that it may lead to ecosystem instability and collapse under a novel climate (Millar et al. 2001; Stephenson et al. 2010). This criticism is not without merit, but it should also not result in the categorical rejection of restoration. Many ecosystems that are "damaged, degraded, or destroyed" are currently more vulnerable to anticipated climate change than were their historical counterparts. For example, forests that have grown dense as a result of logging, grazing, and fire exclusion now are more vulnerable to both drought and the increased fire activity expected to occur in some places in the future. Where restoration of historical conditions appears to confer increased resilience to these disturbances, it should be a priority for management. Where restoration activities would likely leave the ecosystem more vulnerable to climate change, the benefits of such activities (to species conservation, ecosystems services, etc.) should be weighed against potential losses.

Restoration and Timber Management

The National Forest Management Act was written at a time when the national forests were assumed to have the capacity to produce resources and values indefinitely. Timber production was considered a primary use, to be discouraged only when it clearly conflicted with the production of other resources and values. NFMA therefore required the identification of areas that were not suitable for timber production because of physical, economic or other "pertinent" factors and assumed that all other lands would be suitable for production. The strength of this assumption is reflected in NFMA's language directing the review of suitability determinations every ten years and the "return" of unsuitable lands to timber production when conditions change, despite that fact that nowhere does NFMA indicate that the default purpose of the national forest system is timber production.

This assumption that national forest land should be allocated to timber production unless otherwise excluded, based only on soil, slope, regeneration potential, and water quality considerations, is an anachronism and should not apply to a 21st century Planning Rule. The Proposed Rule appropriately describes the purpose of national forest management under the Multiple-Use Sustained-Yield Act of 1960 to be "to sustain the multiple uses, including ecosystem services, of its renewable resources in perpetuity while maintaining the long-term health and productivity of the land." Achievement of this purpose requires determining the desired conditions of the land that will sustain its biodiversity and productive potential and letting those conditions dictate appropriate uses. Allocation of land to timber production should occur only after desired future ecosystem conditions are determined to be consistent with the conditions created by timber production. As timber production is defined (FR, p. 8525) as "the purposeful growing, tending, harvesting, and regeneration of regulated crops of trees…for industrial or commercial use," the allocation of land to timber production should occur only where the forest composition and structure of stands resulting from the agronomic forestry model are determined to be part of the desired ecosystem condition and where their harvest will achieve the goal of sustaining ecosystem sustainability and diversity described in Sections 219.8 and

219.9. Section 219.11(a)(1)(iii), which finds land to be not suitable if "[t]imber production would not be compatible with the achievement of desired conditions and objectives established by the plan for those lands," is consistent with this understanding but is somewhat ambiguously worded and could be improved to make clear that timber production is appropriate only where commercial forest conditions are consistent with the requirements for ecosystem sustainability. Since the agronomic model generally results in the creation of artificially uniform and well-stocked stands, with little of the structural diversity important to native species, very little of each forest should be found suitable for timber production.

While the Proposed Rule seems to imply that the vast majority of any given forest is likely to be found unsuitable for timber production, restoration and resilience management are anticipated to result in vegetation treatments that will yield timber, even where timber <u>production</u> is inappropriate. Because NFMA requires the establishment of an allowable sale quantity "equal to or less than a quantity which can be removed from such forest annually in perpetuity on a sustained-yield basis," it must be determined what the likely future yield will be from a forest in its desired future condition, including that portion where timber production is determined to be appropriate. While the allowable sale quantity should generally be limited to this amount, NFMA does allow for the allowable sale quantity to depart from the long-term average, provided that "any such planned departure must be consistent with the multiple-use management objectives of the land management plan" (NFMA Sec. 1611(a)). Thus, the amount of timber that may be produced from an anticipated restoration and resilience management program may be factored into an allowable sale quantity for any given plan. Section 219.11 of the Proposed Rule contains a number of other antiquated provisions that derive from the timber bias of NFMA but is generally consistent with the application of modern principles of restoration forestry and resilience management. The Proposed Rule should be improved by deleting Section 219.11(a)(2), which unnecessarily commits to timber production all lands not explicitly identified as not suitable (NFMA does not require the identification of lands suitable for timber production), and clarifying that timber production will be appropriate only on those lands where the stand conditions produced by a regulated forest contribute to ecosystem sustainability.

Recommendations

In consideration of the foregoing, the Planning Rule would be better able to achieve its purpose of "a planning rule that protects, reconnects, and restores national forests and grasslands for the benefit of human communities and natural resources" if it were modified according to the following recommendations:

- Clarify that restoration is concerned with reestablishment of the composition, structure, or processes of ecosystems in the direction of their historical range of variability. Management that intentionally takes ecosystems in a direction away from their historical conditions is *not* restoration.
- Explicitly require the designation of management zones dedicated to 1) maintaining the resilience of ecosystem services and values, 2) restoring the composition, structure, and processes of historical ecosystems, and 3) protecting untrammeled landscapes to strengthen the role of reserves in climate adaptation.
- Clarify that timber production is appropriate only where the stand conditions produced by timber production are part of the desired landscape condition necessary to achieve sustainability and diversity under Sections 219.8 and 219.9.
- Delete Section 219.11(a)(2) and clarify that the allowable sale quantity should be based on the activities necessary to achieve the Sustainability provisions of Section 219.8 and 219.9 in perpetuity.

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