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Subject: Final Report from the Science Consistency Check Team on the Sierra Nevada Forest Plan Amendment

To: Regional Forester

The findings of the Science Consistency Check review of the Draft Final EIS for Sierra Nevada Forest Plan Amendment are presented in the enclosed report. This report was prepared by the team leader, Dr. James Quinn, and team facilitator, Michael McCoy, from the University of California at Davis. I have also enclosed Jim Quinn's transmittal memo to me and a document describing some observations on the process by Mike McCoy. These documents offer some useful personal insights and thoughts on the exercise beyond the specific comments presented in the report. The final Science Consistency Check report itself, includes an overview and summary of the results of the Science Consistency Check and summary of comments for each of four key central topics (Species Viability, Fire and Fuels Management, Old Forest Conservation, and Aquatic Conservation) and, as an appendix, individual summaries by each of the 15 members of the Science Consistency Check team. I will not attempt to interpret the details and results of the review for you in this memo, but will let the report speak for itself. I believe, in reading the report, you will find that the team generally concluded that the basic scientific underpinnings of the draft FEIS are sound, particularly for an effort as complex and far reaching as the Sierra Nevada Forest Plan Amendment. This does not, however, represent unconditional concurrence with all scientific aspects of the final document. Discussion on various concerns and comment is included in the summaries of individual reviewers.

Peter Stine and I, with help from several other PSW scientists, developed the review process and selected the participants; a complete description of the process and list of participants is contained in the report. The review team was composed of 15 scientists from federal, state, and academic institutions from throughout California and the West. Members were selected because of their recognized scientific credentials and direct familiarity with both the Sierra Nevada region and the issues upon which the pending management decision turns. Execution of the review session and development of the subsequent report were left under the control of the team and its leaders. Peter nor I have made any modifications to the team's report. I believe the review team did an excellent job, under very demanding circumstances, of reviewing the use and presentation of the underlying science contained in the draft FEIS. In organizing the review, we attempted to follow the Science Consistency Check model used for the Tongass National Forest Plan Revision. While we attempted to use the Tongass model, there were significant differences in both the time available and the particular circumstances of the Sierra Nevada Forest Plan Amendment that forced us to make significant modifications. Our underlying goals, however, were the same. At the close of our two and one-half day meeting in Davis, the team expressed general satisfaction with the process and the way the review was conducted. There were, however, some provisos, most notable were the

limited time available to complete the task and lack of a complete and final document for the review. The November 6 version of the draft FEIS provided by the Interdisciplinary Team for the Science Consistency review was still under development at the time and some sections were missing. The Science Consistency team indicated that the incomplete draft and time available for the review were not sufficient to allow the degree of thoroughness that they would have desired. Notwithstanding this, the overall reaction of the team to the quality of the scientific evidence presented in support of your pending decision remained positive. We do not suggest that this experience forms an ideal model for future Science Consistency Checks, such as those now called for in the new Forest Service land management planning regulations, but I believe that under the circumstances, we were able to conduct a solid review of the consistency of the science in this draft of the FEIS. I am very comfortable with the outcome of the review and am especially appreciative of the time and effort these very busy people dedicated to our task.

I hope these results provide you with sufficient information to enable you to make decisions regarding completion of the Sierra Nevada Forest Plan amendment effort. I will be happy to discuss any questions you may have on the review and/or results.

GARLAND MASON
Acting Director

enclosure

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Date: December 21,2000

To: Garland Mason
Peter Stine
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From: Jim Quinn
Sierra Nevada Forest Plan Amendment Project, Science Consistency Check Team Leader
University of California, Davis

Attached is a final report from the Science Consistency Check (SCC) Team for the Sierra Nevada Forest Plan Amendment Project. It represents a summary of the deliberations of the SCC Team during three days of meetings at the University of California, Davis on November 13-15, 2000, and extensive written comments from Team members then and since. Written reviews from individual panelists are given in their entirety in the appendices. Summary sections attempt to capture and organize the major points from the panel's deliberations and the reviews. The document also contains introductory materials describing the Science Consistency Check process.

The summary statements represent an overview of the discussions of the SCC panel on species viability, fire and fuels, old growth conservation, and aquatic community conservation. As readers will note, no consensus is reached on many issues, and none was sought. The intention instead is to represent a range of scientific viewpoints evaluating the completeness of information and robustness of the analyses leading to the Final EIS. As reporter, I have necessarily condensed and made some editorial decisions on what comments most directly addressed our core charge to conduct a science consistency check (is the data and methodology in the mainstream of accepted scientific procedure?), and which ones were either more editorial or more in the flavor of a peer review (what is the most probable interpretation?) The latter are valuable and were passed on to the EIS Interdisciplinary and Science Teams in the form of original reviews and drafts of individual sections, but are not necessarily reported in the summary of the Science Consistency Check. While I received considerable and valuable feedback from

SCC Team members on the summary, I remain responsible for remaining errors and omissions.

All members of the panel have had the opportunity to review several drafts of the final report, and have provided numerous suggestions that have been incorporated or summarized. One panelist was not able to review the final draft report. Panelists William McKillop and Lynn Decker expressed substantial concerns with the document. While I have tried to address their misgivings in the final draft, either or both may decide to transmit separate evaluations of the FEIS and the SCC process. The other members all have said that they support the transmission of the document as written, although, naturally, none agrees with everything it says.

The panel asked that certain caveats be understood in reading the SCC Report:

(1) We all support the idea of a Science Consistence Check. However all panelists expressed some degree of concern that the process in this review was premature and rushed. The documents provided to the SCC were both incomplete and not yet adequately cross-referenced, making checks for consistency across subject areas difficult. While some reviewers cautioned that "consistency" was not really adequately checked, we believed the review validates the general scientific approach embodied in the draft FEIS, and produced a considerable amount of specific advice that will help improve the final FEIS and ROD;

(2) Science Consistency Checks need more time and more nearly completed documents than we had in this case. Most panelists felt that one or more additional meetings could have substantially improved the quality of the analysis;

(3) If the process of reviewing integration issues is to be a major part of a SCC process, extensive cross-referencing is necessary. In fact, the group thought that it would be worthwhile in the future to prepare large FEIS documents in hyperlinked text;

(4) In the opinion of most panelists, reviewing individual topic areas was feasible, but the integration and adaptive management assessments were not possible to do adequately with the time and information available;

(5) The Forest Service might want to routinely assemble a science advisory group akin to this one earlier in the EIS drafting process, and use it for a combination of peer review, science consistency checking, and advice on analysis and presentation. Other large interdisciplinary studies, such as those sponsored by CALFED and the Bay-Delta Interagency Ecological Program, have Science Advisory Groups that meet two or three time per year. A number of panelists have been involved on both sides of such review processes, and suggest that they might provide reasonable models for large projects like the Framework;

(6) Whether there will be successful adaptive management is a key question in judging the scientific adequacy of this document, since many analyses and decisions are (necessarily and properly) deferred.

On behalf of the entire group, I would like to extend our thanks to the support and assistance we received from the Interdisciplinary and Science Integration teams, and from the staff of PSW. However successful or unsuccessful we find individual pieces of the draft document, we collectively thought that the Interdisciplinary and EIS teams have made an outstanding effort under challenging circumstances. They were uniformly helpful to us – and we wish them success in completing and implementing their review.

Sierra Nevada Forest Plan Amendment Project
Science Consistency Check

Some Observations from the Moderator

The many participants in this process deserve our thanks. The organizers assembled a Science Consistency Check Team of 15 scientists of exceptional talent and dedication. Collectively, they represent a range of organizations and viewpoints, and decades of experience researching the science behind strategies for managing rare species, fire, forests, rivers, and sensitive habitats in the Sierra Nevada and elsewhere. They were asked to digest some 1800 pages of draft Environmental Impact Statement documents in a very short time, and, nevertheless, managed to produce extensive and thoughtful reviews and suggestions. The attached documents attempt to summarize their deliberations and comments.

As an exercise in natural resource planning and protection, the Sierra Nevada Forest Plan Amendment Project is almost unprecedented in its scope and complexity. It arose in part from the Congressionally-mandated Sierra Nevada Ecosystem Project, and strives to apply the results of that multi-year assessment of science and policy in the Sierra province to amend the Land and Resource Management Plans for the Modoc, Lassen, Plumas, Tahoe, Eldorado, Stanislaus, Sequoia, Sierra, and Inyo National Forests in California, the Lake Tahoe Basin Management Unit, and the portion of the Humboldt-Toiyabe National Forest in the Sierra Nevada in a way that is consistent, effective, and based on sound science. The Environmental Impact Statement reviewed by the Science Consistency Check Team is a critical step toward that goal.

Neither the draft FEIS documents nor the reviews are without their flaws. The FEIS was assembled by a small team with limited resources operating under short and changing timelines. They were charged with synthesizing a huge volume of data, literature, maps and surveys, and a long history of public and private activities on extensive and heterogeneous National Forests and adjoining lands. As the accompanying documents indicate, they were not completely successful. The writing of some sections is far from complete, and cross-referencing and integration need some work. Some data and references that should have been included weren't. Although the incompleteness, inaccuracies, and uncertainties inherent in all ecosystem-scale datasets and models are readily acknowledged, they are mostly un-quantified. Some of the proposed recovery efforts and research and monitoring plans are probably too ambitious, given the personnel, facilities, and budgets available. For some of the management options, some of the recommended practices may operate at cross-purposes. Many of the most difficult analyses and decisions have (mostly rightly) been deferred to a later time.

The Science Consistency Check team attempted to read a huge amount of text, review hundreds of tables and graphs, check bibliographies and model assumptions, and provide feedback on data, interpretation, presentation, integration, and future research and adaptive management policies – all in about a week. All members admit that the process was rushed, and that more time and reflection would have yielded a more complete and balanced product.

The extensive and thoughtful critiques of the Science Consistency Check Team should not mask the underlying reality. The Sierra Nevada Forest Plan Amendment Interdisciplinary and Science Integration Teams have produced a solid, credible, state-of-the-art ecosystem assessment. It represents a substantial improvement over the processes and standards of analysis achieved in earlier Forest Service efforts of comparable scope, and raises the bar for future impact assessments. It can be improved in a number of ways, as can any document so large and complex. However, it should stand up well to public and professional scrutiny.

An inevitable question in any high-stakes public policy debate is whether the underlying scientific analysis is independent and should be accepted as valid by the technical community and the public. Public confidence is undermined if it is thought that the process cherry-picked databases, trotted out discredited theories, paid attention only to information policymakers want to hear, performed analyses guaranteed to produce the desired results, or otherwise cooked the data to validate preferred policies. The principal purpose of a Science Consistency Check is to detect and expose such potential abuses of the scientific process. I can say emphatically that there was no suggestion of these kinds of improprieties uncovered by the current review. Instead, we have a report that more than meets the process and analytical standards of mainstream science, and stands ready to be debated, refined, and tested by the always-skeptical norms of the scientific community.

M. C. McCoy
Davis, California
December, 2000

Final Report

Science Consistency Check

USDA Forest Service
Sierra Nevada Forest Plan Amendment Project

December 21, 2000

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Preface – Process overview

The Sierra Nevada Forest Plan Amendment Draft FEIS Science Consistency Check process was initiated in October, 2000 and will conclude on December 1, 2000. The purpose of the science consistency check is to review the process by which scientific literature and scientific process was used in outlining the environmental condition, environmental management options and environmental impacts associated with the proposed amendments to Sierra Nevada Forest Plans known as the Sierra Nevada Forest Plan Amendment.

This process has little precedent in the U.S. Forest Service and is scarcely represented in the proceedings of any other U.S. or international land use or resource management agency. To date, only one Science Consistency Check, for the Tongass National Forest region, has been completed (one other is still underway for the Interior Columbia Basin), and that one lasted far longer and addressed somewhat different issues than this effort. Indeed, the Environmental Impact Statement process itself is well developed, but there is no standardized process for assessing the relationship of an EIS to the science that should underlay it.

The Sierra Nevada Forest Plan Amendment Draft FEIS Science Consistency Check process essentially consisted of a panel of well known and respected authorities from appropriate environmental disciplines reviewing documents, interviewing Sierra Nevada Forest Plan Amendment EIS and Science staff, engaging each other and EIS/Science staff in discussion and writing their opinions of the relationship between this EIS and the science that underlay it.

It should be noted that the expectations of a Science Consistency Check differ from that of a traditional peer review. It is widely recognized that established scientists will differ in their approaches to and analysis of complex multivariate subjects. However, it is also well known that there is a range of approaches and analytical interpretations that are generally considered professionally appropriate. Peer review generally involves arguments about what works best within the accepted range of professionally acceptable alternatives. The question of "merchantability" is that of asking whether an approach or interpretation is inside or outside of the range of professional acceptability altogether. It is this latter question of "merchantability" which we have attempted to answer. Our Science Consistency Check focused on whether the approaches taken could arguably be said to be "merchantable" within the profession of general ecological sciences and its many specialized disciplines.

The timeframe available for Sierra Nevada Framework Draft EIS Science Consistency Check was limited by legal and administrative constraints. The constrained timeframe did cause some reviews to suffer from a lack of information and certainty. In particular, the November 6, 2000 draft of the EIS provided to the review team is not complete in all sections, is missing a number of tables and references, and lacks much of the cross-referencing between sections intended for the final document. The draft was

provided to the panelists approximately 5 days before the beginning of its three-day review meeting. Consequently, the science consistency check reported here is necessarily less thorough and more provisional than it would have been if there had been more time to review a more finalized document. On the other hand, the Forest Service EIS team made itself available to all reviewers throughout the process, so reviewers were able to obtain a somewhat more complete view of the data considered and analyses performed than would have been possible from the EIS document alone.

Topics Selected

The topic set for the Science Consistency Check included five major topics:

Species Viability
Fire and Fuels
Old Forest Conservation
Aquatic Conservation
Integration and Adaptive Management

Each topic was assessed in detail by at least three reviewers. Within each area, there are several logical subtopics, which were often evaluated individually by the reviewers. For example, the species viability data and assessment methods were rather different for birds than they were for amphibians or meadow bryophytes, and the reviewers reported on each separately. A number of natural resource issues (grasslands and grazing, roads, mines, toxics, recreational uses, resource economics) are peripherally addressed by the EIS, but were not systematically reviewed or discussed by the panel.

Originally, the Sierra Nevada Forest Plan Amendment leaders had recommended that a substantially larger suite of issues be addressed by the Science Consistency Check team. The team leader and facilitator asked that the number of topics be reduced to five focal topics in order to allow for the limited time available for review to be focused sufficiently narrowly that a meaningful depth of review could be conducted with the time and resources available. This request was accepted by the USFS Sierra Nevada Forest Plan Amendment Team.

Team Selected

The team was composed of 15 scientists who met the following criteria; familiarity with the Sierra Nevada ecosystems, expertise in one or more of the focus topic areas, and experience in addressing land management problems. The Check Team was given clear instructions on its charge, the scope of the inquiry and the availability of staff resources for questions (Appendices II-IV) at the time they agreed to serve.

Team Charged

For each natural resource topic, the Science Consistency Check panel was charged with answering four questions:

- Was the full breadth of available scientific information used?
- Was scientific information interpreted accurately and without bias?
- Was uncertainty and risk acknowledged and adequately displayed?
- Are the projected consequences of management actions consistent with scientific information?

The team was specifically admonished not to critique the management options *per se*, but only to evaluate the relationship of scientific information to those options. Members were initially asked to use a 5-point rating scale for each of the four questions above. However, during the meeting a majority of participants objected to this approach and asked to be able to use descriptive adjectives to relate their response to these questions. It was agreed that this was acceptable.

Materials Distributed

Check Team members received hardcopy and CD copies of the Draft EIS sections and appendices containing information related to the topics under consideration. Material was sent on Nov. 6, 2000, and participants were given the contact information for relevant personnel from whom they might receive further information if needed. Not all information that would eventually be available in the EIS was available at this time and this was noted to Check Team members.

Meeting Held

The Check Team assembled on the UC Davis Campus on November 13, 2000. Selected staff of the Sierra Nevada Forest Plan Amendment EIS Science Team and both Region 5 and the Pacific Southwest Research Station Team leaders for the Forest Plan Amendment joined the Check Team at the meeting. The process followed throughout the meeting was to have the lead Check Team members for each topic make a summary statement regarding their initial observations of the use of science in the section of their charge. Each presentation generally reviewed the response to the four questions enumerated above. This was followed by a discussion involving all Check Team members and the Sierra Nevada Framework EIS Science Team. Although no attempt was made for this to be a “peer review” session, many peer-review-like comments were made and the Science Team seemed to be eager to receive them and benefited from them.

No attempt was made to reach consensus on the answers to the four enumerated questions although there was consensus for some of the questions in many of the topical areas.

Team Written Commentary

The lead Check Team members for each topic were asked to submit a written summary of their response to each of the four central questions for each of the topics in their charge. Reviews were received from all Check Team members within 5 days after the meeting.

Analysis of Team Written Commentary

The written summaries prepared by the Check Team members were not in a standardized format. However, most followed a general outline stating the topical area under consideration followed by commentary on the four questions as it applied to the topical area. The Check Team Leader and the Check Team Facilitator further organized these reviews into comparable content units to better enable them to comprehend a comprehensive view of Check Team member input.

Summary Report

The final step in the process was the development of an integrated overview of the Check Team's work drafted by the Check Team Leader with assistance from the Check Team facilitator, and reviewed by other team members as available.

I.
Summary Assessment

The science consistency check itself was intended to address fairly narrow issues of whether the scientific analysis followed scientific procedures broadly accepted by the scientific community and whether development of management alternatives was consistent with that scientific understanding (see Appendix III and IV). More particularly, we asked whether the theoretical framework ("working hypotheses" or "conceptual models", depending on who one asks) on environmental processes are generally accepted by the community, whether description of current status and trends is consistent with the best available data and expert understanding, and whether the analytical methods, statistics, and risk estimations are appropriately used, or whether they introduced conscious or unconscious mis-estimations (statistical biases). We were also especially concerned whether the substantial uncertainties involved were communicated effectively. To address these concerns, we asked each panelist to address each of four questions in the designated areas of his or her expertise:

- Was the breadth of available scientific information used in the preparation of the current Environmental Impact Statement document?
- Was the available scientific information interpreted accurately and without bias?
- Were the risks and uncertainties surrounding the scientific information acknowledged and adequately displayed?
- Are the Projected Consequences of Management Actions Consistent with Scientific Information?

Some panelists addressed more detailed breakdowns of these questions (e.g., differentiating between viability information for raptors versus amphibians, fish, or meadow bryophytes.)

There were significant differences among reviewers in particular assessments, which are described below and expanded in individual statements. Nevertheless, the panel was in substantial overall agreement on the scientific consistency and conformance to normative professional standards represented in the document. Several panelists suggested that the scientific bar has been raised for the SNFP when compared to earlier large-scale EIS efforts, particularly in the species viability and fire sections, and that the assessment is correspondingly more complete. Others thought FEMAT had done a better job on some issues, notably in the aquatic and riparian area.

At the same time, the panel cautions that the draft FEIS and related documents it reviewed were incomplete and still being modified, and that the week available to review and discuss the documents made it difficult to develop a comprehensive assessment. Each panelist reviewed at least the chapters of the FEIS on his or her particular area of expertise, and most of the comments arise from those reviews. No panelist completed a comprehensive review of the entire draft. The limited cross-referencing and lack of indexing in this draft panelists were severely limited the panel's ability to critique the formulation of many crosscutting and integration issues. As a result, the conclusions of

this review should be considered somewhat provisional, and we expect that many of the comments will be addressed in the final FEIS. A follow-up review providing more time to assess a completed FEIS could undoubtedly better address some of the remaining questions about integration and adaptive management.

Was the breadth of available scientific information used in the preparation of the current Environmental Impact Statement document?

Generally, the panel felt that the EIS Interdisciplinary and Science Teams have identified and accurately characterized the major sources of information on the resources reviewed, although it noted a number of relevant but overlooked studies and articles. Not all of the information used is well-described (or in some cases, for example, meadows, described at all) in the current draft of the document. In many cases, discussions with the section authors on the Science Team satisfied reviewers that planned additions will properly address now-missing information, but that assessment is obviously provisional. In other cases, technical information catalogued by the Science Team was not presented in the interest of readability, or was summarized but not referenced. The panel urged that the presentation err more in the direction of better documentation. Of the specific topics reviewed by the panel, the coverage of available information was probably best for species viability, weakest for riparian and meadow communities, and intermediate for old forests and fire issues.

While the panel agreed that much of the status and trend information presented is more or less the best available, it is nevertheless highly variable in its accuracy, completeness, spatial detail, and source. Examples include necessarily incomplete records of rare species occurrences, particularly for species that are cryptic or found in poorly surveyed habitats. Old forest maps may mischaracterize stands (i.e., be classified mainly by commercially important species) or attribute large areas as old forest on the basis of remnant stands. Riparian zones are often smaller than minimum mapping unit of available maps and thus they are not well mapped and inventoried. More generally, vegetation, timber, and habitat maps are typically 20-40% inaccurate (or more, if the scale of the map and the ground data do not match) outside areas that have been explicitly surveyed. Maps or classifications derived from imagery, standard models, and expert opinion each have their intrinsic sources of inaccuracy and bias. Frequently, data gathered for one purpose (e.g., timber volume) was used to parameterize assessments (fire risk, species habitat, etc.) for which it was not intended, leading to unavoidable uncertainty. A number of examples are described below. These are unavoidable flaws of all ecosystem-scale ecological assessments, but need to be described better to readers than they are in the current draft. Particular suggestions for better documenting uncertainty were shared with authors and/or are described below. While the draft is still being written, and data quality descriptions are evolving, the panel expressed the greatest concerns about data quality issues in aquatic and riparian resources, and the least in species viability.

Was the available scientific information interpreted accurately and without bias?

There were some concerns expressed in all sections about interpretation of information and potential biases. Some statistical bias (systematic mis-estimation) is inevitable, and panelists outlined some likely cases and causes. Interpretative bias is more subjective. Panelists identified places where projections seemed too pessimistic. For example, not all wildfire is harmful to habitat or listed species in the burned areas, but several panelists thought that some parts of the document implicitly assumed that increased uncontrolled burning would be uniformly catastrophic (and conversely, at times, that controlled burns were uniformly beneficial to the same habitats). In others, panelists thought the assessments were too optimistic. For example, many areas listed as old growth on the basis of the density of large trees may have been repeatedly entered, with resulting soil compaction and disruption, and possibly increased runoff and erosion. In aggregate, however, there is not an obvious direction in the perceived interpretative biases. There were no stated suggestions that scientific assessments were deliberately biased to promote the Forest Service's perceived policy preferences.

In short, on first two questions (information used, accuracy, and potential bias), the general assessment was that the information on species viability, old forest, fire and fuels, and riparian and aquatic resources in the EIS reasonably represented the best region-wide information on these subjects, with some correctable omissions and needs for better documentation of sources. This is not to say that best information is necessarily adequate information for policy purposes, or that it is free from errors and distortions. Despite a number of specific concerns that are described later, there were no suggestions that the identified omissions and potential biases constitute fatal flaws in any assessment.

Were the risks and uncertainties surrounding the scientific information acknowledged and adequately displayed?

The panel's responses to the third question, on whether risks and uncertainties were acknowledged and adequately displayed, were more heterogeneous. Most panelists thought that the qualitative discussions of uncertainty in their sections were generally accurate, but often too limited. In most cases noted, short additions of text to the final draft would typically suffice to alert readers to the perceived deficiencies. On the other hand, the existing document mostly lacks formal quantitative assessments of uncertainty, such as sensitivity analysis of models and projections to uncertainties in underlying parameters. According to the Interdisciplinary and Science Teams staff present, statistical confidence intervals for many statistics and graphs have been calculated, but were not presented for reasons of readability. The panel urged that more of those be presented, particularly on graphs that now show only expected (mean) results of various alternative assumptions or policies. A number of other issues on which a more formal uncertainty assessment would help inform future research and policy formulation are presented under each topical area. The panel noted repeatedly that estimating associated risks to resources and human populations depends upon both the policy alternative

chosen and the effectiveness of adaptive management procedures to ameliorate those risks in the future.

In general, the treatment of uncertainty was thought to be better in species viability and old forests, than in fire and aquatic and riparian issues. To some extent, this may reflect the degree of completeness in writing the various sections. Panelists expressed concerns about institutional risks and uncertainties (will the Forest Service and co-operators have the resources and political will achieve some of the desired future conditions?) in every topic area.

Are the Projected Consequences of Management Actions Consistent with Scientific Information?

In general, panelists either thought the projected consequences were consistent with the available scientific information, or felt they had too little information to judge. In many cases, as described in the draft FEIS, the available scientific information is too uncertain to predict distinguishably different outcomes among the policy alternatives. As noted in group discussions among the panel and the Interdisciplinary and Science Teams, future projections of resource levels (populations, burned areas, etc.) in a stochastic environment (unpredictable rainfall, ignition rates, etc.) rapidly develop very large confidence intervals when projected very far into the future. Consequently, future projections often have little power to measure the effects of management policies. The more appropriate approach may be to mimic ecological field experiments, where differentials between treatments are measured (fire frequency or bird density after controlled burning vs. mechanical thinning, vs. no action) with the environment varying freely. Estimating differential effects is the analytic approach mostly taken in the draft FEIS. The panel did identify some information inconsistencies in the projected management scenarios themselves (e.g., incompatible assumptions about fire dynamics in habitat with both SPLATs and restored riparian corridors).

The panelists' principal concerns with the consistency of accepted existing science with predicted outcomes had less to do with the Interdisciplinary and Science Teams' choice and application of standard, accepted methodologies (which was mostly solid) than with the suitability of some of those accepted methods. Some (e.g., several widely-applied fire models) are mechanistically-based, but have been calibrated from experiences outside California. Others (for example, corridors connecting subpopulations of rare species) follow from theoretically-derived conventional wisdom of the professional community, but have scant empirical support for this application. Still others (widths of riparian buffer zone) are best viewed as non-scientific, compromise, rules-of-thumb that were modified from guidance contained in other agency EISs (e.g., FEMAT). In these cases, "Science Consistency", as defined in the charge to the panel, does not guarantee that the actual scientific basis for making policy choices is sound. These examples are discussed at length below.

Other Observations

Three days of discussion among the panelists and some 90 pages of written commentary covered dozens of issues, including some that are outside of the principal charge to the panel, but potentially useful to the FEIS authors and the Forest Service. These ranged from concern over confusing graphics in the draft FEIS document to spirited debates about the relative efficacies of proposed alternatives toward particular management goals. Much of the discussion contained recommendations of relatively easy changes in the final document which might make it clearer and better documented, with the inherent uncertainties involved in ecosystem-scale assessments more clearly disclosed. In most cases, the suggestions were addressed directly to the authors of the relevant chapters, and we expect that many will be reflected in the final version. Some of these comments are captured in the individual written recommendations of panelists, and are sampled in the appendices.

Other discussions expanded the basic charge to conduct a Science Consistency Check. The panel spent considerable time discussing the applicability and adequacy of the existing data and analyses to successful implementation of whatever management alternatives are chosen in the Record of Decision. A near-consensus emerged that there were too many gaps in existing species, habitat, fire process, and watershed data and models to design narrowly rule-based scientific prescriptions (including S&Gs) for meeting management goals. However most panelists believe that the existing formulation provides a consistent scientific framework for adaptive management, augmented by effective watershed and landscape analysis, to address the inherent uncertainties and risks. Some concerns about the use of science in setting standards and guidance are discussed under both fire and aquatic issues.

Potential adaptive management approaches arising out of the Forest Plan Amendment process clearly must build on the available science. The need for science-based adaptive management varies from one alternative to another, and all reviewers expressed some reservations that the resources and institutional commitments will ultimately be available to make science-based adaptive management effective. The panel discussed, but did not resolve, concerns about whether the proposed monitoring plan was both feasible and sufficient to meet the needs of adaptive management. Many of the panel comments discussed below and in the appendices address these longer-term information needs. Again, these comments are probably beyond the charge to conduct a science consistency check, but are presented here as potentially useful to the Forest Service in completing and implementing the FEIS and ROD.

II.
Species Viability

The reviewers generally agreed that the discussion of species viability was one of the strongest parts of the draft FEIS, including a solid scientific review, reasonable conclusions, and appropriate guidance for decision makers. The further development of these assessments could benefit from future applications of new, more quantitative tools becoming available to analyze the biology and habitats of rare species, but the current assessment clearly met the criteria for science consistency. The following summary highlights major issues that arose during the panel discussion. More details and additional observations from individual reviewers may be found in Appendix V.

1. Was the breadth of available scientific information used in the preparation of the Environmental Impact Statement?

Yes. The panel felt that most of the generally accepted scientific information on vertebrate and plant species viability in the Sierra Nevada was considered and reflected in the analysis. Indeed the document contains one of the more thorough literature reviews the panelists have seen. Some taxa (e.g., bats) are more thoroughly covered than others (reptiles), but the treatment of all terrestrial species considered seems adequate to support the primary purpose of identifying key habitat requirement and key influences on viability.

Most reviewers noted that the criteria for vulnerability ratings (DEIS Appendix R) are not explicitly stated and appear for the most part to be a synthesis of expert judgement, and are therefore difficult to evaluate specifically. However, the reviewers thought that the vulnerability rankings for the species with which they were individually most familiar were appropriate. Some relevant recent literature on viability assessment from the FEMAT, TLMP, and ICBEMP were not cited, and might provide some guidance on how viability assessments can be improved in the future, perhaps under the Adaptive Management Plan.

2. Was the available scientific information interpreted accurately and without bias?

Yes. All reviewers felt that the information was generally interpreted accurately and without bias.

While the methods used (e.g., vegetation models and the California Wildlife Habitat Relations model to predict vertebrate distributions) are standard, reviewers noted that other poorly known features of the landscape (food supplies, nest cavities, etc.) are also needed to accurately assess viability. Throughout the document, it was noted that scale mismatches (e.g., ecological processes depending on features, such as snags, bogs, or small old-growth groves, below the resolution of maps or model grids) lend considerable uncertainty to assessments. Similarly, landscape geometry (sizes of

individual habitat patches distances between patches, and/or presence of "sinks" of unsuitable or dangerous territory) as well as overall habitat acreage, is generally thought to strongly influence viability. While the discussion and interpretation of these issues follow generally accepted theory in conservation biology, it should be noted that some of these ideas have limited empirical verification on large scales such as the Sierra Nevada ecosystem.

3. Were the risks and uncertainties surrounding the scientific information acknowledged and adequately displayed?

The panelists generally felt that the presentation of risks and uncertainties was adequate. However they made many specific suggestions, some of which are listed in Appendix V. In general, statements about uncertainties in species viability predictions in the EIS are mostly qualitative, as opposed to being derived from any kind of formal sensitivity analysis or statistical meta-analysis, and are therefore their consistency with the underlying data is difficult to critique. Nevertheless, most of the uncertainty statements appeared reasonable and appropriate to the panel. For many species, little or no information exists that would permit a predictive and accurate viability assessment. When no information is available (as for most reptiles), the panel encouraged the authors to say so. As a whole, the draft FEIS's assessments of uncertainties in current status and trends are appropriate and fairly explicit. Statements of uncertainty regarding the differences in projections between the alternatives are fuzzier.

The lack of information linking policy alternatives, adaptive management, and differences in long-term protection disturbed several reviewers. For example, there does not seem to be enough information to determine whether particular meadows important to particular populations of lichens and bryophytes would be protected from grazing or physical disturbances. This is a typical example of the scale-mismatch issue raised above. In general, reviewers thought that the scientific framework was adequate to deal with these uncertainties at the watershed and project level if they are properly incorporated into a long-term adaptive management framework informed by a well designed monitoring plan. Therefore a major, and lightly discussed, source of long-term uncertainty is the institutional commitment, resources, and long-term feasibility of the adaptive management and monitoring plans (DEIS Appendix E). The ability to mitigate uncertainties in the biological science is dependent on appropriate treatment of management "science" and the reviewers were troubled by a lack of discussion of this dimension.

On a very macro scale, many dominant sources of risk, including global warming, population growth, aerial transport of pesticides, and neighboring land uses, are not under Forest Service control. These factors clearly introduce important sources of risk to the plan yet their interaction with factors under Forest Service control are not well understood or described. The separation between risks that can and cannot be addressed could perhaps be better distinguished.

4. Are the Projected Consequences of Management Actions Consistent with Scientific Information?

In general, yes. In fact, it is possible that the treatment of risks is too risk-averse, since unintended consequences of preferred alternatives can be mitigated by later adaptive management. At the same time, while projections at the landscape scale are consistent, they may provide too little information, by themselves, to guide effective protection at local levels where it is most critical. It is possible that Standards and Guidelines (S&Gs) could be so restrictive that they could prevent a reasonable response to new information or changing conditions. Effective restoration and adaptive management depend on a means of addressing current uncertainty that may be characterized by well meaning but ill-informed prescriptive management. A more robust connection between S&Gs and adaptive management measures and practices may be warranted.

For the longer run, all of the reviewers of this section stressed the need to strengthen the outcome scoring procedures and for better document the source of the outcome scoring. There is now some precedent from the Pacific Northwest for less subjective methods of producing outcome scores (especially ICBEMP), and these methods could be used in the Sierra Nevada. While the panel believes the expert opinion approach applied in Appendix R has produced generally reasonable assessments, they could prove difficult to defend in the future.

5. Are there short-term actions that could improve the scientific basis for evaluating the FEIS and subsequent Record of Decision?

Numerous minor suggestions for augmenting the coverage of literature, incorporating additional data, and correcting minor errors of fact were made directly to the chapter authors. Other suggestions included providing more thorough treatment of western pond turtles, and treating fish (which were not explicitly reviewed by the panel) in a way more similar to the terrestrial vertebrates (i.e., performing an explicit viability assessment of each species of concern.) Movements of aggressive exotic predators (for example, invasive bullfrogs and crayfish) diseases, and weeds may also differ among alternatives, due to different levels of access and water transported for fire suppression. Those differences could have significant ramifications for both rare and endangered species and for overall community composition.

6. Are there long-term actions that could improve the scientific basis for decision making?

There was a consensus that an effective science-driven adaptive management program, supported by adequate outcome monitoring, is essential to long-term success.

7. Other issues raised.

There are cross-cutting issues with other topics that were difficult to evaluate at this stage in the drafting process. For example, it is unclear that the combined constraints of plant phenologies, animal breeding seasons, fire control concerns, air quality, etc. in chaparral burns will make the proscriptive S&Gs envisioned in some alternative feasible and effective throughout the Sierra Nevada region. Again, this begs for a more flexible policy that allows the S&Gs to be modified through monitoring and implementation of subsequent post-monitoring adaptive management measures.

III.
Fire and Fuels

The following summary highlights major issues that arose during the panel discussion. It should be noted that projections of future wildfire extent are still under modification, and the panel cannot fully assess scientific consistency of the quantitative analysis that will appear in the final FEIS. However, the reviewers have addressed the process and data underpinnings appearing in the current document. More details and additional observations from individual reviewers may be found in Appendix VI.

1. Was the breadth of available scientific information used in the preparation of the Environmental Impact Statement?

In general, the reviewers felt that the information referenced in the draft Final Environmental Impact Statement represented a reasonable cross-section of available information, but that a number of significant studies, which would have increased confidence in the analysis, were omitted. The FEIS authors have noted these omissions and many will probably be taken into consideration in final drafting of the FEIS. The reviewers broke the science issues of Fire and Fuels into a number of subtopics identified in preparatory materials for the meeting (Appendix II). These are addressed separately below.

Existing hazard and risk: Many important elements (references involving fuels, urban interface, ignitions, etc.) were considered, but inclusion of other useful assessments such as the Fire Plan produced by CDF's FRAP would have strengthened the analysis. The issue of the appropriate baseline period provoked some debate here and later. Fuel build-up and the large increase in wildfire acreage during the last 25 years may render older data of less relevance. On the other hand, the recent data are probably not representative of expected long-term conditions because they are dominated by an unusual 7-8 year drought. Some panelists felt that the FEIS draft given to the panel did not provide enough information about the methods used to evaluate the adequacy of the risk assessment.

Fire as an ecological force: The literature review here is weak. Reference to the work of Biswell, Bonnicksen, Wagener, van Wagtendonk and Kilgore should be cited. Review materials from SNEP could form a basis for a more comprehensive treatment.

Reintroduction of fire: Much better than the RDEIS, but some reference to recent studies in National Parks would be appropriate.

Landscape-scale strategies: There were no concerns expressed on the breadth of the landscape-scale data used. As elsewhere in the documents, there were some worries that "average" scenarios were assessed without formal sensitivity analysis of the importance of variation in driving variables -- even though the text emphasizes such parameters: e.g. the percentage of a watershed treated before the Finney effect kicks in, stand density index and its effects on mortality, future trends in black acres, etc. Although the level of

analysis was recognized by the panel as far better than what has been used in the past, reviewers felt that more formal sensitivity analysis will be needed to provide a scientific basis for distinguishing between future policy choices.

At the micro-scale, new work on ignition of structures in the urban interface was brought to the attention of the EIS authors.

Benefits and liabilities of prescribed fire: Incomplete literature review. In particular, the findings from extensive prescribed fire studies in California national parks should be addressed.

Prescribed fire and mechanical treatment tradeoffs: Some important missing literature, particularly from California National Parks. Reviewers also felt that a broader range of fire models (e.g., FETM) could have been used more effectively to quantitatively predict effects of fuel treatments on smoke, wildfire risk, and vegetation far into the future.

Future fire loss possibilities: Mixed opinion. Predictions of future fire losses are not concisely stated or mapped in the draft FEIS, though reviewers felt that FETM could provide a non-spatial estimation under various treatment scenarios. One reviewer felt that future fire losses were systematically under-estimated, in part by using a debatable historical baseline (1970 to 1996 -- 47,110 acres, rather than 1986 to 1996 -- 72,500 acres plus an allowance for future build-up of biomass), and should be recalculated on a decadal basis using SPECTRUM. These figures may be reassessed in the final document.

2. Was the available scientific information interpreted accurately and without bias?

Existing hazard and risk: To the degree the reviewers could determine it, yes.

Fire as an ecological force: There is a linguistic bias in discussing natural fire as a "disturbance" to the Sierra ecosystem. No concerns were expressed about inaccuracy or bias in the interpretation of data.

Reintroduction of fire: As a whole yes, but there was some discussion of whether the available information supports the assumption that the "ecofire" scenario will restore pre-settlement fire regimes without repeated treatment and/or mechanical conditioning.

Landscape-scale strategies: As a whole yes, with some concerns expressed that the trajectory-altering nature of unpredictable severe events could lead to fundamentally different outcomes.

Benefits and liabilities of prescribed fire: Several concerns were raised. (1) The basis for evaluating smoke effects is unclear, but might be addressed by using the FETM

model to evaluate the costs and benefits of various strategies. (2) Panelists saw potential bias in interpretation both in suggesting that there is no evidence that owls tolerate fire, and in implicit assumptions about fuel treatments' effects on large tree retention. (3) Assumptions about post-fire mortality of large trees are suspect. At very least, the limitations of using FOFEM to estimate post-fire tree mortality need to be described, since parameters in the version used come from the Intermountain West and perhaps the Pacific Northwest. While the Sierra Nevada have some of the same tree species, few if any data from the Sierra Nevada were used to either develop the equations or test the results. The model may also be unrealistically sensitive to assumptions about flame length. (4) The difficulties and liabilities posed by significant levels of prescribed burning without mechanical fuel management may be understated. Risks include air quality restrictions, budgetary constraints, dangers of fire escapement, and very limited periods and opportunities when all of the factors such as fuel loadings, fuel moisture, existence of defensible perimeters, and weather conditions, especially wind velocity, are at levels appropriate to burn.

Prescribed fire and mechanical treatment tradeoffs: Incomplete. Incorporating experiences from National Park studies and ongoing experimental work elsewhere would give a substantially different view of the uncertainties.

Fire loss possibilities: The draft FEIS may misinterpret future fire losses when projected losses are based on historical number of acres burned if the severity of the burn is not considered. Approximately 30 percent of the acres burn by wildfire show non-lethal severity, and figures presented for prescribed fires are similar. The assumptions on future trends and fire frequency (pages 3-181 to 183) assumes that habitat lost to fire will increase if the projection is based on the 1986-1996 fire period. If, however, that number of annual habitat acres burned is reduced by 30 percent to represent non-lethal (frequently desirable) fires, the habitat acres would actually increase, not decrease. However, the data in the draft were too incomplete for the panel to assess this issue properly.

3. Were the risks and uncertainties surrounding the scientific information acknowledged and adequately displayed?

Existing hazard and risk: There is some semantic uncertainty about the meaning of "risk" that bears careful definition. This is especially true for the "risk" of fire. The traditional fire term defines risk as the probability of a fire start. In the EIS, "risk" appears to be defined as the probability of having a fire damage something of value. With uncertainty, "risk" seems to refer to the probability of making an erroneous decision based on the scientific information.

Fire as an ecological force: As a whole, yes. However, because the "Large Fire Analysis…" was unavailable to evaluate, reviewers could not assess if uncertainty and risk are adequately acknowledged, displayed, and incorporated. A presumption that runs through many of the alternatives is that each will reduce the frequency of wildfire. Reviewers disputed this contention, as the number of fire starts is unlikely to decrease

significantly as a result of fuel treatment. The draft FEIS states that there are several instances in which the effectiveness of the proposed fuel treatments has been demonstrated. However, there is little, if any, published data indicating that fuel treatments have altered wildfire character, although there is anecdotal testimony and some in-progress research.

Reintroduction of fire: Yes.

Landscape-scale strategies: Yes, at least qualitatively.

Benefits and liabilities of prescribed fire: Mixed opinion. Several reviewers felt the discussion provided a qualitative but generally accurate description of the uncertainties involved. One feels that the risks of large-scale prescribed burns have been systematically underestimated. Uncertainty of smoke emissions could be estimated by multiplying the emission factor errors, the fuel acreage errors, and the fire acreage errors.

Prescribed fire and mechanical treatment tradeoffs: Generally, yes. Reviewers noted that mechanical treatment may be an appropriate precursor to long-term use of prescribed fire, since it reduces fuel loadings and helps address air quality restrictions, budgetary constraints, dangers of fire escapement, and time restrictions (limited periods and opportunities when all of the factors such as fuel loadings, fuel moisture, defensible perimeters, and weather conditions, and available crews and equipment, are at levels appropriate to burn). Revenue from mechanical removal might also help subsidize more extensive fire treatment.

Fire loss possibilities: Risks and uncertainties are probably misstated, since the basis for projection of fire losses does not adequately take the occurrence of low intensity burn areas in natural fire mosaics into account, although projections of wildfire occurrence now show categories of fire intensity.

4. Are the Projected Consequences of Management Actions Consistent with Scientific Information?

Existing hazard and risk: As a whole, yes. However the operational difficulties associated with large scale use of prescribed fire, such as air quality restrictions, budgetary constraints, and very limited periods and opportunities for using it may have been underestimated, making it difficult to evaluate the long-term consequences of management actions.

Fire as an ecological force: Yes.

Reintroduction of fire: If implemented effectively, yes. However, there are substantial institutional requirements, as well as the biological features of ecosystems, that must be met if the scenarios in most alternatives are to be achieved. These include more personnel, suppression resources, pre-project planning, and regulatory coordination.

Landscape-scale strategies: As a whole, yes. However, the assumptions about the effects of treatments in reducing fire risk are empirically thin. It is not clear that anticipated treatments will necessarily be effective in reducing ignition potential of large, dead woody material, nor it is clear how or if they reduce the risk of human-caused ignitions. Furthermore the DFEIS is relatively silent on the overall anticipated efficacy of SPLAT treatments as a means of reducing the threat of catastrophic fire to the entire landscape. This theoretical expectation, while well supported with modeling results, should be more thoroughly explained as a hypothesis that will be employed and tested.

Benefits and liabilities of prescribed fire: As a whole, yes. However, the predicted effects of prescribed fire on owls, smoke emissions, and large tree mortality may be systematically misinterpreted, and the practical difficulties and liabilities of large scale prescribed burning systematically underestimated.

Prescribed fire and mechanical treatment tradeoffs: As a whole, yes, with the concerns stated above about assumed effects of treatments on fire risk, smoke, and large tree mortality.

Fire loss possibilities: Projected consequences are probably misstated because of the misestimation of burn intensity described earlier.

5. Are there short-term actions that could improve the scientific basis for evaluating the FEIS and subsequent Record of Decision?

Many are discussed above. A framework for a series of SPECTRUM runs to better quantify uncertainties under various future fire scenarios was discussed with the modeling team.

6. Are there long-term actions that could improve the scientific basis for decision making?

The substantial uncertainties in the effects of various management regimes on fire occurrence and behavior need more systematic experimentation. Consistent and well supported monitoring of the success of alternative treatments including substantial pre-treatment and pre-wildfire occurrence sampling of multiple landscapes over a long period of time will be necessary. Long term success requires incorporation of an improved understanding of fire's role in ecology into an adaptive management program.

7. Other issues raised.

Crosscutting issues with other resource types are discussed below.

IV.
Old Forest Conservation

The old forest conservation issue is intertwined with both fire and species viability. As a result, some of the discussion of old forest is reported in those sections. The following is a summary of the written reviews authored by review panel members and group discussions held with the review panel and the old forest experts of the USFS Interdisciplinary and Science Teams as they responded to the core questions of the Science Consistency Check. The following summary highlights major issues that arose during the panel discussion. More details and additional observations from individual reviewers may be found in Appendix VII.

1. Was the breadth of available scientific information used in the preparation of the Environmental Impact Statement?

As a whole, yes. There is a range of data on various spatial scales describing the extent and structure of old growth stands throughout the Sierra, ranging from timber surveys through SNEP habitat maps and studies of individual community types. Reviewers noted that some historical data, including 1930's VTM data and descriptions of trees at section corners from original survey documents could be used to develop a longer-range interpretation of forest change, but not in time for use in the FEIS. Future projections of old forest extent in the current document are covered in more detail than are projections of structure and volume. They could be made more explicit, calculating probable timber volume by decade and management alternative.

While the influence of fire on forests is extensively treated, coverage of forest health issues, including attacks by insects and disease, is covered lightly. Appropriate literature is available to support such a discussion. The document could also do considerably more to discuss predictable future increases in stress on trees, including effects of warming climate, greater deposition of nutrients and probably increased exposure to airborne pesticides and other toxic substances.

More reference to several existing studies, including works by Potter, Fites, Wieslander, and Bonnicksen, could improve the data on current and historical (particularly pre-European) conditions. There is growing evidence that the post-Pleistocene nature of Sierra forests has varied widely, and that immediately pre-European forests were often more open and had a more varied size structure than is typical of LSOG forests today. The consequences of past landscape configurations for resilience of forests and sensitive species populations are difficult to assess. However, to the degree that desired future conditions reflect the nature of historical forests, historical conditions bear more attention.

2. Was the available scientific information interpreted accurately and without bias?

Generally, yes. The reviewers thought the interpretation was well-balanced overall, though there are substantial uncertainties inherent in the information. However they noted that both available data and historical management objectives have lead the alternatives to concentrate, perhaps disproportionately, on forest structure, as opposed to forest composition, driven in large part by the threat of catastrophic wildfire and the structural habitat requirements of a few large old-forest vertebrates of special concern.

The reviewers all noted that the nature and spatial scales of existing data makes the interpretation of patterns and trends in old forests necessarily a somewhat confusing mix of interpretations of information typically gathered for purposes other than conserving old forests. For example, Forest Inventory data is spatially extensive and resolves individual stands of large trees, but has very coarse compositional categories (CALVEG-level) making it unsuitable for identifying the specific stand composition or habitat features required by rare old-forest species. SNEP LSOG data, in comparison, has much finer compositional resolution, but typically only treats forests in polygons of 500 to several thousand acres. As a result, smaller stands of old forest, which may be important from a conservation perspective, may be lost from the analysis. Old forest maps produced by mixing low spatial resolution sources with low compositional resolution have the potential to compound the errors of both, resulting in mediocre overall map accuracies, not atypically in the 40-60% range (e.g., the Langley report in SNEP). However these uncertainties are well understood, and are well-described in the draft FEIS document and elsewhere, such as in the SNEP report. One panelist noted that a particular viewpoint (which might be considered a defensible interpretational bias) on how to address these uncertainties, described in the SNEP chapter by Franklin and Fites-Kaufmann, is strongly represented in the EIS document.

Because of the nature of the data, statistical biases (in this case, systematically over-estimating or under-estimating old forest extent and properties) are likely, and can lean in either direction. Examples cited by the reviewers include areas mapped as having no old forests because small old growth patches represent a minority of a mixed seral-state polygon (leading to an underestimate of extent), and others where properties of a subset of a polygon in old forest have been assumed to apply to the entire polygon (i.e., an overestimate). These kinds of problems may lead to large commission errors on the distribution of old forest (Table B-2).

Similarly, properties of data describing stands gathered for other purposes may lead to polygons being systematically mis-classified. For example, classifying stands primarily by potential production of large conifers has led to large mid-elevation areas that are predominantly a diverse mix of oaks and shrubs being classified as “Ponderosa Pine” (because of a >10% cover of pine). Much of the information needed to protect major elements of floral diversity, and habitat elements important to many animals, is lost in this kind of misclassification. Similarly, stands of similar structure are treated as

equivalent throughout the Sierra Nevada, despite the fact that there may be a 50% or more change in overstory and understory plant species composition within a vegetation class from Modoc to King's Canyon, with comparable changes in physical environment.

The panel raised another accuracy issue associated with the operational definitions of old forest used in the analysis. These are generally based on size and density of large trees rather than history. Therefore, some stands that have been entered repeatedly are treated as interchangeable with un-entered stands of old growth. The two kinds of stands might be managed quite differently. For example, managers might choose of apply only prescribed burns to undisturbed old growth in order to minimize soil compaction, increased erosion, and habitat integrity. Mechanical thinning might be much more acceptable in already disturbed forests.

It should be noted that un-entered stands or patches of old growth do not necessarily represent pre-European-settlement conditions, since fire exclusion in many areas may have created denser forest conditions than existed in the 19th century. Bonnicksen and others have noted that multi-layer closed canopy forest may have been rare at the time of European colonization. More generally, forest extent, compositions, and fire regimes have varied widely since the Pleistocene, and it should not automatically be assumed that current LSOG classifications define desired future conditions.

Concerns about the estimates of fire effects on forests were reported in the previous section, and most apply to old forests. Estimates of future acreage subject to natural fires depend upon the base period chosen for comparison, and should be adjusted for predictable future changes in both fuels accumulation and climate.

3. Were the risks and uncertainties surrounding the scientific information acknowledged and adequately displayed?

As a whole, yes. As in most other sections of the draft FEIS, reviewers noted that there is relatively little quantification of uncertainty, and little or no formal sensitivity analysis. Projections of old forest extent over time present expected values under the various alternatives, but do not portray confidence intervals. As in other sections, the panel suggested that tables and graphs present uncertainty estimates.

The reviewers noted that the degree of uncertainty depends upon the objectives being addressed. For example, the interpretation of recovery of old forest values other than timber volume is complicated by the characterization of old forest by dbh classes and densities rather than history and seral stage. Recovery of soils, woody debris, and understory structure and diversity in entered forests may not be closely related to the status of their largest trees, and could take decades. Similarly, mapping by structural features may be of limited value in projecting stand composition, fire behavior, or species habitats, since the underlying forest inventory data was never intended for those applications.

Among formal uncertainty analyses available, a panelist suggested that Langley's analysis for SNEP provided the most useful current assessment, and that the conclusions reached by Langley should be presented in greater detail and considered more fully in terms of the uncertainty of the LSOG information. Quantitative comparison of wildlife occurrence data to the various forest structural data were also suggested as a means of estimating uncertainty, as were quantitative comparisons of R5 forest inventory maps to SNEP data.

4. Are the Projected Consequences of Management Actions Consistent with Scientific Information?

Responses here varied. No reviewers reported fatal flaws, but some found the information too incomplete to draw firm conclusions. As with other topics, it was difficult to evaluate the consistency of cross-cutting objectives. The panel noted that the five problem areas considered in the EIS are very different in their applicability both within and among the various national forests. Three problem areas involve ecosystems and associated species (old forest, aquatic, hardwood), one is a process (fire) and one is a particular set of species (noxious weeds). Fire and weeds cross ecosystem types, but also interact with each other (fire controls some weeds and promotes others) and management options (i.e., mechanical thinning will likely introduce disturbance-adapted weeds, such as star thistle.) As with other integration issues, the panel saw the potential for contradictory Standards and Guidelines governing inter-related processes, but did not identify particular examples.

As noted in the previous section, most panelists thought that the draft FEIS is confusing in its treatment of fire effects on natural forests. On the one hand, it asserts that fire must be returned to the system (i.e., burned acres increased) and that wildfire extent is less of a concern than fire severity. The report then proceeds to use burned area as the basis for comparing alternatives, with the explicit assertion that more wildfire is undesirable. This approach implies that all wildfires are bad and all controlled burns are good. Similarly, there is little or no attention to the effects of mechanical fuel thinning on soil structure and hillslope processes. The ecological comparability of mechanical thinning and burning remains an open question.

The panel also raised the issue of whether institutional uncertainties had been adequately addressed. These include institutional commitment and adequate resources for monitoring and evaluating outcomes of alternative management methods. Indeed, several panelists doubted whether ambitious plans under some alternatives for fuels management, old growth regeneration, and detailed monitoring (Appendix E) were budgetarily feasible. On the other hand, they noted substantial dangers in applying rigid management prescriptions without sufficient flexibility and adaptive management. For example, the use of 1.5 mile-wide urban intermix zones would have disproportionate affects on those kinds of environments where settlement occurs (valley bottoms, lower footslopes, some ridges). If these S&Gs were followed literally, giving precedence to fuel reduction throughout these zones could have serious consequences by differentially affecting specific habitats and subregions.

5. Are there short-term actions that could improve the scientific basis for evaluating the FEIS and subsequent Record of Decision?

Many specific suggestions to expand and improve the discussion of old forest data, interpretation, and documentation of uncertainty in the draft FEIS arose in discussions with the FEIS authors, and in the written suggestions of panelists (Appendix VII).

6. Are there long-term actions that could improve the scientific basis for decision making?

Higher resolution maps (e.g., stand-level) of more discrete vegetation types, land cover, and land use, covering the Sierra Nevada (or the state) with standardized themes and classifications, at least for purposes of cross-referencing, would address many of the important data uncertainties described above. Criteria for such a mapping system have been proposed by the Gap Analysis program, the National Vegetation Mapping initiative, and several interagency groups within California, among others. However, consensus standards and sustainable funding mechanisms are still to be established.

More historical research may also be valuable. If it may be assumed that pre-European fire regimes, seral mosaics, forest structures and plant communities provided more suitable habitat for rare species and some protection against catastrophic wildfire, recovering more of those conditions represent a desired future condition. Bonnicksen and others provide a framework for such assessments.

There was a consensus that longer-term, flexible, science-based adaptive management is essential to maintaining sustainable old forest values is a shifting multiple-use forest mosaic. Achieving success involves not only adequate research and monitoring, but also addressing the social trust issues so that potential legal and political opponents can be assured that flexible management is not a pathway to bypassing legal or societal objectives.

7. Other issues raised.

The suggestion was made that the draft FEIS needed much more detailed information on the direct and indirect benefits and costs of various alternatives to long-term timber production, employment, the local economy, and national income. Several panelists felt that if such information were included, the economic analysis should also try to address the corresponding economic values of shifts in recreational use, forest "ecosystem services" and "non-market" environmental amenities – the magnitudes and measures of which are controversial within the economics community. Some suggestions from individual panelists are included in the appendices, but this issue falls outside the main charge and background materials delivered to the panel, and is little discussed in the current draft FEIS. As a result, the panel had neither the time nor the information to

address it adequately. Nevertheless, if the FEIS addresses the effects of alternatives on forest "ecosystem services" and "non-market" environmental amenities it must also address the effects of alternatives on non-market impacts on society such as effects on family stability, increased dependence on welfare, health effects, decrease in affordability of homes, and increased dependence on non-wood substitute materials.

V.
Aquatic Conservation

The Science Consistency Check panel's assessment of the sections of the EIS document on aquatic, riparian, and meadow (ARM) resources was more heterogeneous than for species viability, fire, or old forests. The general consensus of the panel was that, among the topics reviewed, this section needed the most work. In part, this undoubtedly reflects the fact that the Nov. 6, 2000 draft FEIS provided for review had substantial sections that were not complete or final, and the materials on some issues, such as meadows, were largely absent. However, members of the Interdisciplinary and Science Integration teams participating in the discussion suggested that the teams were less expert on ecosystem processes in lotic and lentic ecosystems than in some of the other assessment areas. A number of the comments below will be presumably be addressed in the final FEIS. This review can only be considered provisional until the EIS text assumes its final form.

1. Was the breadth of available scientific information used in the preparation of the Environmental Impact Statement?

Mixed verdict. There was an extensive province-wide review of information on aquatic, riparian, wetland, and meadow communities in SNEP, and the draft FEIS cites the SNEP documents extensively. The reviewers did not identify any major scientific findings since SNEP on Sierra Nevada aquatic resources that had been omitted or which might alter the principal conclusions of the document. However, citations of new literature, particularly for riparian systems and small-to-intermittent streams, were limited, and the panel suggested numerous individual references that should be discussed and cited. Among areas with new science, the treatments of scientific advances on amphibians and introduced fish since are accurate, though the documentation should draw on the primary data and literature rather than the review papers that are cited in this draft.

A different concern arose on the strategy for establishing vegetation buffers in riparian zones and along streams. While rules-of-thumb (75 foot buffers, buffer widths related to tree height, different buffers for ephemeral and intermittent streams than for permanent ones, etc.) suggested for various alternatives have been implemented through other EISs elsewhere (e.g., the Northwest Forest Plan), most represent pragmatic negotiated compromises. Without a process-based rationale grounded in hydrologic, soil, vegetation and associated sciences, a Science Consistency Check cannot judge whether their application in the Sierra Nevada is consistent with scientific understanding.

The reviewers felt that the scientific basis (or lack thereof) for treatment of riparian buffers (including Riparian Conservation Areas) was not adequately described, nor, indeed, were the principal objectives for establishing protected buffers around waterways. Several reviewers think there is a need to return to first principles and thoughtfully analyze environmental processes and goals (habitat, intercepting nutrients,

erosion control, shading and water temperature, etc.) to assess requirements for conservation in these habitats. It was also noted that different analyses are appropriate for lakes vs. streams, permanent vs. intermittent waterbodies, and normal vs. extreme events.

Similar concerns were expressed on the need to express the scientific or historical basis for S&Gs and goals, including stating, when appropriate, that a given standard (e.g., 10% bank damage due to grazing) has no explicit scientific underpinnings, but is based on customary past practices instead. Other numbers needing documentation examples include stubble heights, TOCs and ERAs.

2. Was the available scientific information interpreted accurately and without bias?

Opinion varied. Some reviewers thought the interpretations in this section were generally accurate without obvious biases, others felt information was interpreted far too optimistically. All noted that there was inadequate documentation and cross-referencing, making detailed assessment difficult. Many of the consistency check reviewers concerns address the tone of qualitative descriptions as much as disagreements over particular hard data.

Some of the specific reviewer comments, by area, include:

Aquatic resources: "While SNEP did say that there were greater problems as you moved to the valley floor, they did not portray conditions as good on the forests as implied. I believe there is a contradiction also in the CWE/ERA discussions where it shares that the FS own data shows a significant number of watersheds in poor condition. It would be helpful in all these sections to cite references or the agencies' own data instead of the general reassuring narrative that predominates the Aquatic, Riparian and Meadow sections as well as the water quality sections."

Restoration: Several panelists worried about a tone they felt implied that any degraded waterway or bank can be restored. They suggested tempering the discussion with (1) more effort to distinguish between restoration (i.e., toward presettlement conditions) and rehabilitation (enhancing biological value or function); (2) recognition that some degraded states (eutrophied or silted lakes, many drained or silted meadows, etc.) are not restorable with current understanding, technology, and budgets; and (3) acknowledgement of the limited predictive abilities of much contemporary restoration science.

Riparian buffers: See above. At very least, the process of sediment and nutrient delivery into waterways could be better developed, thus improving the discussion of consequences for the various alternatives.

3. Were the risks and uncertainties surrounding the scientific information acknowledged and adequately displayed?

Mixed verdict. The panel felt the discussions of uncertainty for hydrological issues and aquatic species of concern was appropriate, but that for riparian and meadow communities needed work. There was a consensus that the *ad hoc* historical basis for some restoration prescriptions, riparian buffer strategies, and fire management options needed to be better disclosed. More generally, several panelists recommended that a more systematic attempt to describe the sources and uncertainties of S&Gs were essential if the forest plans and adaptive management strategies were to maintain sufficient flexibility to avoid counterproductive prescriptive actions.

Reviewers identified a substantial risk of contradictory restoration goals and prescriptions for riparian zones and stream buffers vs. upland forests. Continuity of riparian habitats for both bank protection and wildlife corridors is an often-stated goal of riparian restoration and management. Fire management strategies, on the other hand, emphasize discontinuities (e.g., SPLATs) so that the spread of large wildfires is disrupted. Particularly if meaningful buffers are established along upslope ephemeral streams, there can be considerable overlaps in areas targeted for riparian restoration/protected vs. fuel load reduction. Depending upon the ignition properties of riparian vegetation types, which are inadequately described in the draft, continuous riparian corridors might frustrate the intentions of upslope fuel management activities. Conversely, it is not clear how controlled burns around stream buffers affect their vegetation or the passage of sediments and nutrients. We know that hot fire historically have burned riparian vegetation, but the impacts of cool fires, including prescribed burns, are inadequately documented.

As in other sections, institutional risks are an important element of the uncertainty in predicted effects of alternative strategies. Candid assessments of the potential for successful implementation of major changes in management direction are essential. Although many of the goals are commendable, they may not be practical. Does the USFS have the qualified personnel and funding to prepare thorough watershed analyses? Does the USFS have the qualified personnel and funding to implement fuels treatments across vast areas of the range? Will the USFS obtain sufficient funding to adequately maintain the current road system, let alone make significant progress in rehabilitating roads that are the primary sources of accelerated sediment delivery to streams? Will there be funds, materials, and sufficient expertise for extensive riparian restoration? It is hard to separate these questions from more purely scientific evaluations of risk and uncertainty yet it is clear that uncertainty in management strategy could be a larger source of variance than suggested miscalculation in data analysis.

4. Are the Projected Consequences of Management Actions Consistent with Scientific Information?

Again, a mixed opinion, for many of the reasons cited above. In general, the reviewers felt that the projected impacts on hydrology and aquatic species were reasonable and consistent with available data. There was some worry that some of the scenarios for effective restoration of riparian vegetation, meadows, and other wet habitats were too optimistic, and that restoration goals could be locally incompatible with preferred fire and fuels management strategies. Several reviewers felt that the existing literature and agency information show that anticipated vegetation management practices (notably buffer widths) are sometimes inadequate to protect streams from excessive non-point source inputs of sediments and nutrients. Strategies for riparian buffers tailored to local conditions clearly represent an important information gap to be filled by new research, success monitoring, and commitment to adaptive management. In the interim, panelists believe the available data suggests strengthening protective buffers.

5. Are there short-term actions that could improve the scientific basis for evaluating the FEIS and subsequent Record of Decision?

Many suggestions for better documentation and discussion of uncertainty were raised in discussion and communicated directly to the Interdisciplinary and Science Integration teams. Some are captured in reviewer write-ups and Appendix VIII.

Several reviewers thoughts that explicit development of more mechanistic process-based models, even if qualitative ("conceptual models") would assist in documenting the basis for recommended practices and S&Gs, and help in both guiding implementation, assuring consistency and in highlighting information needs for future research and adaptive management.

6. Are there long-term actions that could improve the scientific basis for decision making?

The cross-topic integration issues are particularly important for aquatic and riparian communities, since they transect all other habitat types, and receive and transport materials from each. Because of scale, taxonomy and methodological differences, there has been an understandable disconnect between historical aquatic research and monitoring activities in riparian and aquatic ecosystems and those in forests. Given the interdependency and potential conflict between desired future conditions and S&Gs for streams, riparian, and surrounding forests, not only will effective monitoring have to be coordinated or combined, but institutional mechanisms will have to be developed to evaluate and intelligently manage tradeoffs between valid but competing goals.

7. Other issues raised.

The last point in item #6 above raises the need for an institutional strategy that identifies information gaps at the landscape and watershed level and deploys resources to address them.

The reviewers understand that if a range-wide plan framework is not sufficiently rule-based (e.g., embodies supportable S&Gs), it will not promote standards, or trust. On the other hand, reviewers recognize that if there are not relatively objective methods of identifying conflicting or counterproductive practices, well-meaning but stringent and possibly blind implementation of management measures can promote unexpected potentially catastrophic conservation failures. The panel reviewed draft documents that provide suggestions for such mechanisms, and urge the FEIS authors to craft the adaptive management and monitoring strategy sections to accommodate these kinds on needed institutional innovations.

VI.
Integration and Adaptive Management

During the Davis meeting, the Science Consistency Check panel did not conduct an independent review of the Integration and Adaptive Management discussion in the Draft FEIS, although it attempted to address both issues in the context of individual topic areas, as discussed earlier. In large part, this was because the panel did not feel able to do justice to integrative issues under the time constraints for both reading the entire document and covering other materials in the group meeting. The FEIS authors also had not completed much of the cross-referencing in the draft that they expect to include in the final FEIS.

Integration and adaptive management issues discussed earlier include a number of cases where there are conflicting demands and potential incompatibilities among recommended practices to manage different resources. Examples include:

- air quality consequences and restrictions on prescribed burning
- trade-offs between restoring riparian corridors and thinning upland fuels
- trade-offs between fuel management and closed forest species habitat

A repeated theme of the discussions was the risk that prescriptive Standards and Guidelines can potentially conflict with effective adaptive management. On the one hand, there is an understandable desire to have a set of rules that guide management actions and give confidence to the general public that the Forest Service intends to do the right thing. On the other hand, it is possible – even likely—that these S&Gs will prevent managers from responding to monitoring results that suggest other actions may be more suitable or even necessary. The panel did not resolve the dilemma. Perhaps minimum S&Gs are the most appropriate, with instruction to increase levels of protection immediately if it appears that the minimum levels are not enough.

Institutional needs cross-cutting issues involve

- the need for feasible and coordinated monitoring strategies
- the need to better integrate biological and economic projections
- the trade-off between flexibility and assurances in adaptive management

Reviewers repeatedly noted that an important risk in achieving desired future conditions for a number of alternative strategies was whether the Forest Service and cooperating agencies would have the institutional commitment, personnel, and resources necessary to achieve the ambitious goals outlined in the FEIS. There was a consensus that long-term success is entirely dependent upon developing and sustaining a sophisticated adaptive management program for Sierra forest and aquatic resources. The group discussed some strategies with the Interdisciplinary and Science Integration Teams, but did not reach firm conclusions on best directions.

The panel's ability to evaluate the treatment of economic consequences of alternatives was superficial at best, in part because the relevant analyses (FEIS Chapter 2, Section 4 – Comparison of Alternatives, and documents describing the ROD) were not provided to the committee. Some of the missing elements are outlined in the Old Forest discussion and in Appendix IX. Concerns included whether projections of harvest and employment were as detailed as they could be (e.g., using SPECTRUM for long range projections), and whether considerations of forest "ecosystem services" and "non-market" environmental amenities would be appropriately balanced by effects of alternatives on non-market impacts on family stability, increased dependence on welfare, health effects, and decreased affordability of homes. If these issues are addressed in the FEIS, the panel recommends a separate consistency check.

Written comments from the reports of individual reviewers addressed a number of other integration and adaptive management issues. Some of those are presented in Appendix IX.

All members of the Science Consistency Check Team strongly support the value of Science Consistency Checks. However the majority, either in their written reports or in panel discussion, expressed concern about whether the panel had the information or the time to adequately review an incomplete FEIS draft for internal scientific consistency across multiple resource topics. They were more comfortable reviewing the individual chapters (species viability, fire and fuels, old forests, and aquatic conservation). If time permits, the panel recommends a similar review of the completed FEIS, with more time to conduct the evaluation, to adequately address the crosscutting scientific questions. In any case, future SCC processes will be more informative if integration questions receive more advanced preparation and reviewers have more time to respond.

Appendix I.

USDA Forest Service
Sierra Nevada Forest Plan Amendment
Science Consistency Check
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Appendix II.

Charge to the Science Integration Team and Questions for Review

File Code: 1920 **Date:** October 27, 2000

Route to:

Subject: Sierra Nevada Science Consistency Checks

To: Peter Stine, Science Integration Team Leader

To facilitate your timeline, Brad Powell, Regional Forester, has asked me to respond to Garland Mason's memo of October 23, 2000 concerning the science consistency check.

Your proposed approach appears sensible and should help the Regional Forester answer the question as to whether we have made good use of the available science in preparing the environmental impact statement that will be the basis of his decision for the Sierra Nevada Forest Plan Amendment Project. I suspect that it may be difficult for your scientific review team to definitively settle on "yes" or "no" answers to your questions, so a numeric score may accommodate uncertainty or doubt about the team's response to our work.

I hope it will be clear to the consistency check team that the decision will provide an integrated solution to the five problem areas of old forest; fire and fuels; aquatic, riparian, meadow; noxious weeds; and lower Westside hardwood forest conservation. The alternatives presented in the final EIS will portray a range of choice for solving the five problems. In developing the alternatives we have used available scientific information in three key ways:

1. To explain existing environmental and social conditions and, in some cases, the circumstances or factors that have created those conditions.

2. To describe future desired conditions for the environment.

3. To design the means to reach those desired future conditions.

The alternatives differ in their environmental and social effects, so we have also made extensive use of scientific thinking and information to evaluate their consequences.

While the scope of the EIS and resulting decision are broad, it is important for the review team to have a feel for the special challenges the Regional Forester will confront in making his decision. None is more important than the simultaneous need to provide

for the viability of the species that depend on the national forests for habitat, and to deal constructively and aggressively with the threat of wildfire and associated need for fuel treatments. Considerable energy has been devoted to developing choices for addressing these issues, and in developing the environmental, social, and economic consequences of the various choices.

A second important issue is sustainability. While sustainability can be variously defined, the question confronting the Regional Forester is whether we have sufficient confidence, grounded in scientific thinking, that the chosen alternative will launch the national forests on a path that can be sustained in the face of the major sources of environmental change--natural succession, drought, disease, and fire—while fulfilling our social, economic and legal obligations to citizens today and in the future.

I have appended a list of specific questions that include the two themes mentioned above, but give you a more detailed list of specific questions by issue area. We are prepared to assist in your review, and I look forward to receiving your findings.

KENT P. CONNAUGHTON

Sierra Nevada Framework Project Manager

Questions by Issue Area

1. Old Forest conservation.

a. Have we adequately characterized the existing condition of vegetation on the national forests?

b. Have we adequately considered the forces affecting vegetation change and projected the consequences of proposed allocation and management activities?

c. Have we adequately captured the issues of geographic and temporal scale in describing vegetation dynamics, disturbance, and ability to reach desired future conditions?

2. Fire and fuels.

a. Have we adequately portrayed existing hazard and risk across the national forests?

b. Have we adequately considered the influence of fire as a disturbance force affecting the landscape?

c. Have we adequately developed strategies that permit the reintroduction of fire as a natural ecosystem process?

d. Have we developed a range of landscape-scale strategies to provide choices for dealing with forest fuel conditions and values at risk?

e. Have we adequately portrayed the benefits and liabilities of using prescribed fire and mechanical treatments as management tools?

f. Have we adequately portrayed the trade-off between mechanical and prescribed fire fuel treatments?

g. Have we adequately displayed an instructive set of scenarios about fire loss possibilities in the future?

3. Species viability.

a. Have we adequately described existing habitat and population conditions for the species that are the focus of this EIS?

b. Have we adequately described the threats—natural as well as human-caused--to the species that are the focus of this EIS?

c. Have we adequately portrayed a range of choice for providing short-run protection to the species that are the focus of this EIS?

d. Have we adequately portrayed a range of choice for providing long-run restoration and perpetuation of the species that are the focus of this EIS?

e. Have we adequately recognized the needs for or opportunities to address risks and uncertainties for species conservation in an adaptive management context?

Aquatics.

f. Have we adequately portrayed the range of conditions found within California's watersheds in the Sierra Nevada?

g. Have we adequately identified the need for restoration and provided the tools to carry out restoration?

h. Have we adequately identified goals that would guide watershed management?

i. Have we adequately developed the analytical foundations to facilitate aquatic, riparian, and meadow conservation?

4. Integration.

a. Have we adequately identified the uncertainties and risks of managing in riparian areas for fire and fuels, habitat conservation, and human access and use?

b. Have we adequately identified tradeoffs between fire and fuels management and habitat conservation needs?

c. Have we adequately evaluated and displayed the economic and social consequences of the proposed management strategies?

d. Have we adequately provided the means to assure ourselves that any given solution is environmentally sustainable?

e. Have we adequately developed an approach to adaptive management that deliberately develops information to revisit our assumptions, develop new information, and lift the veil of uncertainty?

Appendix III.

Instructions from Science Integration Team Leader to SCC Team Members

Science Consistency Check
Sierra Nevada Forest Plan Amendment
November 13-15, 2000

Introduction

The U.S. Forest Service is planning to make a decision that will result in changes in how the National Forests in the Sierra Nevada and Modoc Plateau are managed. The Sierra Nevada Forest Plan Amendment (draft) Final Environmental Impact Statement (FEIS) presents eight different alternatives for stewardship of national forests in the Sierra Nevada and Modoc Plateau. The objectives of the alternatives is to sustain desired conditions of old forest ecosystems; protect and restore aquatic, riparian, and meadow ecosystems; improve fire and fuels management; combat noxious weeds; and sustain desired conditions of lower Westside hardwood ecosystems in the affected national forests. The alternatives include a preferred alternative and a "no action" alternative. The alternatives describe different possibilities for amending the Land and Resource Management Plans for the Modoc, Lassen, Plumas, Tahoe, Eldorado, Stanislaus, Sequoia, Sierra, and Inyo National Forests in California, the Lake Tahoe Basin Management Unit, and the portion of the Humboldt-Toiyabe National Forest in the Sierra Nevada. The alternatives would also amend Regional Guides for the Intermountain and Pacific Southwest Regions. The EIS describes and discloses the expected environmental consequences of the eight alternatives considered.

The Science Consistency Check is a relatively new process that will continually evolve as a requirement of Forest Service planning and decision making. Concern over public land management decisions has grown in recent years and correspondingly, public agencies have responded by developing methods that increase their accountability in significant land use decisions. At the heart of most Forest Service decisions is scientific knowledge that contributes to establishing policy and management. All parties concerned with the outcome of land use decisions call for credibility of the scientific information that supports any given decision. Revised planning regulations that implement the provisions of the National Forest Management Act (1976) that require a Science Consistency Check for all forest plan decisions are soon to be issued by the Secretary for Agriculture.

Scientists provide managers and policymakers with the fundamental information for making reasoned decisions, but policy issues, not science, dictate the decisions. The significance of scientific information in supporting policy decisions is based on several key assumptions: that objective and rigid scientific protocols are used in developing new information and in integrating and synthesizing existing and new information; that the information is interpreted correctly; and that the assessment of the probable consequences associated with various proposed management actions is based on unbiased fact. Thus

the fundamental purpose of a Science Consistency Check, as we are preparing to apply it to the Sierra Nevada Forest Plan Amendment, is to evaluate the scientific information embedded in the FEIS for up to four main purposes:

- Was the breadth of available scientific information used in the preparation of the FEIS and subsequent Record of Decision (ROD)?
- Was the available scientific information interpreted accurately and without bias?
- Were the risks and uncertainties surrounding the scientific information acknowledged and adequately displayed?
- Are the Projected Consequences of Management Actions Consistent with Scientific Information?

Process of a Science Consistency Check for the Sierra Nevada Forest Plan Amendment

The Pacific Southwest Research Station of the Forest Service (PSW) has the role of providing scientific support to the EIS process, including completion of this Science Consistency Check. Many PSW scientists have been closely involved in the development of the scientific information included in the FEIS. In order to provide an additional level of objectivity, PSW has chosen to form a team of scientists who meet the following qualifications:

a. they must be independent of the Sierra Nevada Forest Plan Amendment EIS process;

b. they must have scientific credentials in one or more of the areas related to the key decision issues; and

c. they must have familiarity with the Sierra Nevada ecosystem.

The format for a Science Consistency Check has not been standardized. We are basing our approach on lessons learned from the Science Consistency Check developed for the Tongass National Forest Land Management Plan Revision, completed in 1997. The Science Consistency Check for the Sierra Nevada Forest Plan Amendment focuses primarily on the science behind the key elements of the decision, i.e. the five main problem areas (see a brief description of each problem area below and a more detailed description in the FEIS). These are the set of pivotal issues and questions upon which the decision will depend.

The function of the Science Consistency Check is not to evaluate the Forest Plan Amendment decision itself, rather the purpose is to evaluate the scientific foundations and interpretations within the EIS that support the decision. The Science Consistency Check team will examine the salient portions of the FEIS including material that supports the preferred alternative. The team should evaluate the FEIS in the light of the technical material that is required in an EIS of this magnitude (e.g. a thorough and well documented discussion of the affected environment and environmental consequences, a clear description of the alternatives), and not for what might be in a scientific document regarding management in the Sierra. This distinction should be kept in mind so that the team's expectations of the FEIS are placed in the proper context. The scientific analysis contained in the FEIS should be able to support whatever decision is made. This is a NEPA document and it should be able to serve the NEPA disclosure and analysis of probable effects of alternatives purposes accordingly.

In consultation with the Regional Forester and the staff of the Sierra Nevada Framework management/EIS team, we have developed a summary list of the key issues that the Regional Forester would like the Science Consistency Check to evaluate. This list is meant specifically to focus the attention of the Science Consistency Check team to key management questions, and represents an attempt to maximize the team's ability to review as thoroughly as possible the scientific information underlying the decision, within the time available. The objective of this exercise is to examine the scientific information that bears directly on the elements of the decision, not on every management issue in the Sierra that may be of concern. This decision relates strictly to a Forest Plan Amendment pertaining to the five stated problem areas.

It must be emphasized that the execution of this Science Consistency Check is being performed within a timeframe that has been set by Forest Service decision-makers. Scientists are typically conservative in their conclusions, and often prefer to take more time to probe deeper and more thoroughly. Given the short timeframe within which the team must work, the level of detail that can be addressed in this review will be limited. The team is expected to focus on the general scientific adequacy of the information that addresses the key issues and concerns. This review is not intended to be a "warranty" for all the science used in this FEIS. However, it should provide some clarity and definition regarding the three fundamental questions stated above, as they relate to the key issues.

The results of this independent Science Consistency Check will be transmitted as a report to the Station Director of PSW. The report will be forwarded, with minimal editing and refinements, to the Regional Forester by the Station Director. How the information contained in this report is used will be the Regional Forester's decision. However, we expect that the Regional Forester will weigh carefully the conclusions of this team to help him determine whether the FEIS provides the high standards of scientific rigor upon which he can base his decision.

The Proposed Action of this EIS

The Forest Service proposes to amend land management plans for the Modoc, Lassen, Plumas, Lake Tahoe Basin Management Unit, Tahoe, Eldorado, Stanislaus, Sequoia, Sierra, and Inyo National Forests in California, and the portion of the Humboldt- Toiyabe National Forest in Nevada that is in the Sierra Nevada to address the problems of: (1) old forest ecosystems and associated species; (2) aquatic, riparian, and meadow ecosystems and associated species; (3) fire and fuels; (4) noxious weeds; and (5) lower westside hardwood forests. Each of the Land and Resource Management Plans for the affected forests and Regional Guides will be amended with this updated management direction.

Scientific thinking is varied and public expectations are not definitive for any of these problem areas. As a result this proposed action will be coupled with an adaptive management strategy that is integral to a more thorough understanding the resultant outcomes of the proposed action and an ability to adjust management, as needed, using additional scientific information. Adaptive management procedures will be used to adjust management direction for future events, changing knowledge, or dynamic social views. Adaptive management involves: (1) establishing desired outcomes and steps towards achieving them based on scientific knowledge and assumptions about what is possible and what it would take to reach desired ends (this is essentially a management analog to hypothesis testing, which is used in research), (2) conducting inventories,

monitoring, and research to generate new information (essentially "reading the management experiment,") and (3) adjusting management objectives and strategies in response to the new information (the adaptation part). The proposed action thus identifies potential monitoring and research to provide the critical information needed to initiate management adjustments. Through adaptive management we learn from experience and use that knowledge to adjust policy.

The proposed action also calls for an assessment of existing environmental conditions and identification of management options at various geographic, jurisdictional, and temporal scales to: (1) link decisions at the project scale to forest plan decisions, (2) link forest plans to the efforts of other agencies, (3) prioritize treatments within the watershed or sub-watershed, and (4) facilitate local collaborative stewardship.

Decision to be Made

The responsible officials will decide whether or not to amend the Land and Resource Management Plans for the Modoc, Lassen, Plumas, Tahoe, Eldorado, Stanislaus, Sequoia, Sierra, and Inyo National Forests in California, Lake Tahoe Basin Management Unit, and the portion of the Humboldt-Toiyabe National Forest that is in the Sierra Nevada.

Decisions involved in the selection of an alternative will include adoption of the following, which are necessary to resolve the five problem areas:

- Management direction and goals;
- Desired future conditions expected over the next 50 to 100 years;
- Standards and guidelines to be used in designing and implementing future management actions;
- A strategy for inventory, monitoring, and research to support adaptive management, i.e., to measure progress toward attainment of desired conditions and to make adjustments in management where needed.

The Record of Decision for the Sierra Nevada Forest Plan Amendment EIS will amend current national forest land management plans and regional guides where they conflict. The relevant parts of the selected alternative will become part of the amended plans and will guide activity-level decision making until replaced through subsequent amendment or revision. Management direction and land allocations in existing plans will remain in effect unless they are superceded by or found to be in conflict with decisions made through this planning effort. The Regional Foresters for the Pacific Southwest Region and Intermountain Region will be the deciding officials. Both Regional Foresters will sign one Record of Decision.

Format of the Science Consistency Check

The basic objective of this Science Consistency Check is to evaluate how thoroughly and effectively the available body of scientific information was used in considering the key issues that this set of decisions is addressing. The FEIS is not meant to be a scientific, peer-reviewed document and thus we do not expect it to be evaluated as such. However, we expect that this review will evaluate for each key issue area whether 1) the Breadth of Available Scientific Information Used 2) the Scientific Information Interpreted Accurately and Without Bias 3) Uncertainty and Risk Acknowledged,

Adequately Displayed, and Appropriately Incorporated in Alternatives and Analysis of Consequences and 4) the Projected Consequences of Management Actions are Consistent with Scientific Information? The underlying objective is to ensure that current scientific thinking is appropriately part of the planning process. It goes without saying that it is of the utmost importance that the team members provide objective scientific critique, and avoid injecting personal beliefs, values, and interests.

This Science Consistency Check will be led by Jim Quinn and Mike McCoy from the Information Center from the Environment at U.C. Davis. Jim will also be part of the team. They will guide the discussion and take the lead in assembling the material generated by the team. The team will receive further instruction from Jim and Mike subsequently.

To maximize the effectiveness and efficiency of this process the format will consist of the following stages and elements:

Preparation (by individual team members) (through November 12th)

1. The currently available text of the Final Environmental Impact Statement will be provided to each team member on a CDROM. Please be advised that this text is still in draft form. The text will be searchable to enable quick and efficient location of relevant information. A hard copy of the text will also be provided for reference purposes.
2. Attached to this document is a letter from the Sierra Nevada Framework Project Manager, Kent Connaughton, describing the needs of the Forest Service with respect to this Science Consistency Check. In particular, Kent Connaughton, on behalf of the Regional Forester, has identified the key issues that they believe bear most significantly on the decisions to be made.

We are trying to be mindful of the time it will take for each scientist to review the salient portions of the document for a given topic. Thus each team member is asked to focus their evaluation on only two issues, issues that are within their area of expertise. See the attached list of general topics and how we have apportioned the team members to topics. The team leaders, Jim Quinn and Mike McCoy, will work with the issues suggested by Kent Connaughton to select two issues per person. Team members will hear more from them on this prior to the session on the 13th. Please let us know if you have any problems with how this has been done. Roughly three or four scientists will address each issue. Although each team member will focus only on certain issues, all team members will be encouraged to contribute to any issue during the discussions on November 13-15.

3. Prior to the meeting on November 13-15, each member is asked to consider a preliminary rating on a scale of 1 to 5 (see explanatory notes at end of table) for each of their focal issues. Team members should come prepared to present and discuss their ratings in the facilitated dialogues. We suggest that each team member also prepare a preliminary scoring for their issues and a preliminary narrative to explain their score. Team members will have the opportunity to finalize each after the topic has been discussed during the session. See below for details.

November 13-15 Session in Sacramento (all team members)

At the meeting on November 13-15, the team will discuss each issue as a group and work with the team leaders to provide individual comments where appropriate. Team leaders and facilitators will lead the discussions, ensuring that each issue receives complete coverage. Sierra Nevada Framework ID Team and Science Team members will be available during the discussions to answer any questions. Toward the end of the three-day session, team members will be asked to finalize their scores and narratives. Narrative comments will be compiled into a summary table. As appropriate, team members should explain how each score might be improved. Remember, the primary audience for the narrative explanations will be the ID Team and the Regional Forester. They will have the Science Consistency Check report prior to finalization of the decision and the issuance of the FEIS and ROD so they can address the concerns raised, if feasible.

The output of this session will simply be a scoring of each topic (see attached list of topics and the four questions for each topic, including scoring guidance) and a brief narrative explaining each score. Before you leave the session, or by the end of the next day via email, we will ask each team member for both the scores and the narratives for each score for the topics addressed by each team member. You can provide it in written or electronic form. We will make arrangements to have some laptop computers at the session or alternatively, bring yours if you have one. The team leader will receive and compile this input.

Draft Session Agenda:

Nov. 13th

10:00 AM Introductions (all)
10:15 AM Discussion of the Purpose of a Science Consistency Check (PSW)
11:00 AM Overview of the Issues within the Sierra Nevada Framework (Region 5)
12:00 Noon Lunch
1:15 PM Describe Procedures for Reviewing Topics
1:30 PM Begin Review of Topics

5:00 PM Adjourn for the Day

Nov. 14th

8:00 AM Continue Review of Topics

10:00 AM Break
10:15 AM Continue Review of Topics

12:00 Noon Lunch
1:15 PM Continue Review of Topics

5:00 PM Adjourn for the Day

Nov. 15th

8:00 AM Continue Review of Topics
10:00 AM Break
10:15 AM Continue Review of Topics
11:15 AM Discuss Conclusions
12:00 Noon Adjourn

November 16-27 (team leaders/facilitators, team members, Station Director)

A draft report will be assembled by the team leader/facilitators, with the help of PSW staff, and submitted to each team member by November 20th.

In the interest of time, the draft report from the November 13-15 meeting will also be shared with the ID Team so that the issues raised at the meeting can be addressed as soon as possible.

Team members will be asked to return comments on the draft by **no later than November 27th**. Comments will be incorporated into a final report to the PSW Station Director.

The Station Director will transmit the final report of the Science Consistency Check team to the Regional Forester on November 29th.

Appendix IV.

Letter from Team Leaders to SCC Team.

To the Science Consistency Check Team –

We are delighted to have an opportunity to work with you on the Science Consistency Check team. Given the magnitude of the task facing us, and the short time horizon, we suggest the following approach to focus our activities.

Let's keep the limits of our assignment in mind. The letter from Kent Connaughton to Peter Stine (see Peter's 10/30/00 e-mail) outlines the information Regional Forester Brad Powell most needs from this group. Note how the questions are posed. We are not being asked to provide a comprehensive peer-review of the science in the EIS, much less whether we believe the policy resulting from this scientific information is appropriate.

The questions, instead, are whether the identification of topics, ecological processes, threats, data sets, and analytic methods follow accepted norms of the scientific community. Specifically, the charge from the PSW Science team (memo from Peter Stine) is that for each resource type (old forest conservation, fire and fuels, aquatic conservation, species viability) we should evaluate the following scientific process issues:

- *Was the breadth of available scientific information used in the preparation of the FEIS and subsequent Record of Decision (ROD)?*
- *Was the available scientific information interpreted accurately and without bias?*
- *Were the risks and uncertainties surrounding the scientific information acknowledged and adequately displayed?*
- *Are the Projected Consequences of Management Actions Consistent with Scientific Information?*

In preparation, we would like you to review the text in the supplied documents, on your assigned resource type, and prepare a brief written summary (preferably in Microsoft Word) addressing each of the preceding questions for that resource type. In particular, if you think the treatment was flawed, try to address what it would take to improve it to the level of accepted scientific practice. If you wish, you may subdivide the resource type into more manageable subtopics. For example, under species viability, the answers to the process questions might be very different for raptors versus amphibians. Feel free to examine any resource category outside the one you are assigned but be prepared to discuss the one assigned to you.

During the meeting, we plan to compile and edit the assessments you have prepared. We will have several laptops available for this purpose. Bring disks or your own machine.

It is inevitable that challenges to the Record of Decision will assert (among other things) that the supporting material in the Draft FEIS was based on "bad science". Our job, in part, is to give Brad Powell an objective basis for responding to questions about the use of science in the process.

The purpose of the working group next week is to carry on an informed conversation on these issues, and to capture it into a summary document with supporting appendices as appropriate, and to provide the Pacific Southwest Research Station of the Forest Service with a consistent scoring of the supporting information used in developing the scientific basis for each major issue. We do not necessarily want to reach consensus (on the contrary, we want each team member's individual point of view), and will not make policy recommendations, but we should strive to reflect the scientific community's viewpoints on how science in the Sierra Nevada can best support public policy.

A draft agenda is included in the materials from Peter Stine. Our goal is to treat each major resource topic (old growth, fire, water, rare species) in 2-3 hours, starting with short (10-15 minute) presentations of the issues from the topic team, followed by group discussion, and possibly breakout discussions and/or writing time. The Sierra Science team will have subject experts available for questions, and we will take formal notes. The team leaders will facilitate the discussion, and capture the key conclusions to be included in the summary report. The final session will address integration and cross-cutting issues. While some members' schedules require that we end our group discussions midday on Wednesday, a subgroup will stay on to begin writing. Volunteers are welcome. Participants will be asked to write supporting materials reflecting the discussions of their assigned topics, and to review text before transmittal.

Questions about support documents may be directed to Peter Stine. Feel free to contact either of us about the content and process of the workshop itself.

This should be a stimulating exchange of ideas. We look forward to seeing you.

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Appendix V.

Reviewer Comments on Species Viability

Species Viability -- Reviewer Comments from Peter Brussard:

The answers to the questions below are based my assessment of the treatment of terrestrial vertebrates, the group with which I am most familiar in the Sierra Nevada.

To assess potential changes in viability, a species list of terrestrial vertebrates was drawn up from the California Wildlife Habitat Relationships (WHR) system. After casuals and outliers were edited out, an assessment of current viability was made for about 425 species by considering (1) reduction in historical range, (2) estimated population size, and (3) population trends. Most of this information came from the scientific literature and expert opinion. Species were divided into high, medium, and low risk categories.

The viability consequences of the eight alternatives in the EIS were then assessed for the high-risk and some of the medium-risk species. Environmental outcomes were estimated by using data on species-habitat-relationships from the WHR system and projecting changes in habitat quantity and quality expected under each alternative. Next, potential population outcomes were assessed by considering factors largely outside of the Forest Service's control. A combination of environmental and population outcomes then were used to project species viability into the future.

While this level of analysis might seem to be somewhat superficial, it is currently state-of-the-art. Existing habitat and population conditions are not well known for many of these species, so it is hard to project the consequences of management actions on them with a much higher degree of accuracy. Thus, monitoring and adaptive management will have to play a key role in conserving viable populations of most species.

1. Have we adequately described existing habitat and population conditions for the species that are the focus of this EIS?

While the combination of vegetation models and the WHR system provides useful measures of expected changes in gross habitat features, such measures do not capture the full array of habitat needs for each species. WCR habitat types are usually designated by vegetation structure (e.g., forest, woodland, grassland) and the names of one or two dominant plants. However, animals invariably require other compositional elements (e.g., birds may require certain species of plants for fruits or seeds) and processes (e.g., raptors need herbivory to convert primary productivity into something they can eat). To a certain extent, these can be managed for as part of habitat as well, and they could have played a larger part in the discussions on viability.

The small-patch ecosystem species cannot be considered adequately at a landscape scale and should have been treated separately. Although this was done to some extent, it should have been more explicit in the document.

2. Have we adequately described the threats--natural as well as human-caused--to the species that are the focus of this EIS?

Threats tend to vary by taxonomic group. For example, the threats to amphibians are fairly well-known, and they were treated reasonably well. However, some threats discussed in the recent literature were missed such as the interactions among disease, parasites, and habitat conditions under a changing environment.

3. Have we adequately portrayed a range of choice for providing short-run or long-run protection to the species that are the focus of this EIS?

This is not a detailed conservation strategy for Sierra Nevada species, nor is it necessarily intended to be. It does provide a wealth of hypotheses (e.g., the probable effects of various alternatives) that will have to be tested through adaptive management.

4**. Have we adequately recognized the needs for or opportunities to address risks and uncertainties for species conservation in an adaptive management context?**

There is certainly recognition of the fact that species persistence in the Sierra Nevada can be threatened by factors over which the Forest Service has little control. These factors include deposition of pesticides from the Central Valley, climate changes, and exotic species introductions.

There perhaps needs to be a clearer distinction made among (1) things we know for sure, (2) things we think we know, and (3) things that have a large component of uncertainty. The latter includes the initial viability assessment. Errors made here can have serious consequences later on; a species judged to be in good shape today when in fact it is not suddenly can become a serious problem tomorrow. Thus, plans should be made to revisit this list at regular intervals.

There are several types of uncertainty that should have received more attention. First, the effects of global change (increasing temperature, CO2, and ultraviolet radiation, land use changes, population pressures, etc.) will have large and unanticipated effects on species viability. Second, modeling errors--starting with the reference condition--can propagate at every level, producing viability estimates with very broad confidence limits. And third, there seems to be no accommodation for truly unique events that can result in the demise of small-patch ecosystem species--the landslide that takes out most of a salamander population, for example.

Because of this high level of uncertainty, monitoring and adaptive management will have to become an integral part of species viability conservation. However, two factors may inhibit effective adaptive management. The first is the change in Forest Service culture that will have to occur for adaptive management to become a reality in that agency. The second is the traditional management split with the Forest Service looking

after the habitat and the Fish and Wildlife Service and state fish and game agencies tending to the species themselves. Both of these items should be addressed if the Sierra Nevada is to keep its current complement of native species.

Summary

1. Was the breadth of available scientific information used?

Although some of the recent literature on amphibian stressors was missed, I thought that the team did an excellent job of ferreting out the relevant information for assessing viability. Score = 4+ to 5-.

2. Was scientific information interpreted accurately and without bias?

I did not detect any systematic biases in interpretation. Matters of scale may not have received as much attention as they should have. Score = 4+ to 5-.

3. Was uncertainty and risk acknowledged, adequately displayed, and appropriately incorporated in alternatives and analysis of consequences?

I have discussed this in some detail above. There is certainly an acknowledgement of uncertainty and risk in the document, but I wonder if these factors are as appreciated to the extent that they should be. This assessment, state-of-the-art as it may be, is little more than informed guesswork. Score = 3+.

4. Are the projected consequences of management actions consistent with scientific information?

This is the most difficult to assess. The scientific information is limited, and the consequences are projected under great uncertainty. Again, careful monitoring of the effects of management actions on species viability is necessary, and this must feed back into changes in future management. Score = 3+.

Species Viability – Reviewer's Comments from David Graber:

Thank you for including me in the Science Consistency Check for the Sierra Nevada Forest Plan Amendment Draft Final EIS. I attempt below to respond as best I can to the questions raised by you and your colleagues. I must begin, however, with several caveats: It was not possible in the short time available to carefully read the entire body of material that was sent to me, although I did eventually consume at least eight hours in reading, not counting the time we spent as a team and all the time I have spent reviewing previous drafts. That means, however, that it is certain that I missed or misunderstood important elements, and the connections among elements. Secondly, the stage of editing of the version I received is still sufficiently rough that navigating it was often a frustrating challenge. There were numerous errors that appeared mostly to be typographic in nature, but could be substantive. An example is Table R.3, where important cell value labels are not consistent with Table R.1. I urge you to conduct a thoroughgoing edit of the entire document.

Referencing of sources was inconsistent and sometimes thin, making it difficult to ascertain what the basis of a particular statement or conclusion was. This is a serious point: I would be far more comfortable and confident in my "assessment" if all sources of information and all reasoning were made explicit; i.e. there would be no black boxes and "professional judgment" was the basis of last resort. That said, I acknowledge that for the magnitude and complexity of the Framework, such would be enormously more time-consuming and expensive.

Because this is a "check" and not a true review, my responses to your questions likewise possess uncertainty, and reflect "best likelihood" statements rather than assertions on my part.

1) Was the Breadth of Available Scientific Information Used?

It appeared to me that in the area of species viability, where I devoted the bulk of my attention, most generally accepted scientific information was at least considered and reflected in the analysis. The apparent reliance on technical experts (Table R.2) rather than literature to estimate vulnerability for the full suite of Sierra Nevada vertebrates made it impossible for me to know what scientific information was used.

2) Was Scientific Information Interpreted Accurately and Without Bias?

I found no evidence of bias in any of the scientific conclusions. I did find what I consider to be errors of fact—based on *my* reading of the same body of literature—but these are all trivial, appear to be the result of the huge size and complexity of the task, and don't appear to significantly affect any analyses or outcomes. I did notice a tendency to accept the conclusions of published literature uncritically, even when there were other plausible explanations for phenomena. However, this is understandable given the nature and scale of the problem.

3) Was Uncertainty and Risk Acknowledged, Adequately Displayed, and Appropriately Incorporated in Alternatives and Analysis of Consequences?

I consider the analyses to be conservative, and weighted towards risk-averse management. For the most part, uncertainties are identified forthrightly. However, without true implementation of comprehensive monitoring connected to a functional adaptive management

scheme such as is presented in Appendix E, risk would become significantly greater than otherwise for all alternatives.

4) Are the Projected Consequences of Management Actions Consistent with Scientific Information?

For the [at risk] species treated in detail, I found projected consequences very consistent with scientific information.

Additional species viability questions:

Have we adequately described existing habitat and population conditions for the species that are the focus of this EIS? To the extent that data are available, yes.

Have we adequately described the threats—natural as well as human-caused--to the species that are the focus of this EIS? Yes.

Have we adequately portrayed a range of choice for providing short-run protection to the species that are the focus of this EIS? Yes

Have we adequately portrayed a range of choices for providing long-run restoration and perpetuation of the species that are the focus of this EIS? Yes

Have we adequately recognized the needs for or opportunities to address risks and uncertainties for species conservation in an adaptive management context? You recognized these needs and opportunities; the test will be implementing adaptive management to cope with the risks and uncertainties.

I conclude by saying that I have confidence in the analyses in the Forest Plan Amendment FEIS, and am likewise convinced that there is excellent correspondence between the analyses and the alternatives presented.

Thank you for the opportunity to contribute to this monumental effort.

Species Viability – Reviewer's Comments from Martin G. Raphael:

Question 1. Was the breadth of available scientific information used?

The available documents contain some of the better literature reviews I have seen. For each of the species of viability concern addressed in Chapter 3, a very thorough review of relevant literature in included. Although treatments vary among taxa (bats are covered in more detail than other species groups), the treatment of all terrestrial species seems adequate to support the primary purpose of identifying key habitat requirements and key influences on viability. The treatment is not as thorough in Appendix R, which provides the basis for the vulnerability ratings used to screen species for subsequent analysis. Recent methods developed for the viability assessments of the FEMAT, TLMP, and ICBEMP are not cited in the review of approaches for assessing risk. The outcome scale used for the overall environmental ratings is taken from Lehmkuhl et al. (1977) and Raphael et al. (2000) and Raphael et al. (in press) but these sources are not cited.

Question 2. Was scientific information interpreted accurately and without bias?

In most respects, I believe the answer to this question is yes. The various projections of habitat conditions and effects of standards and guidelines are presented in a very open manner with no obvious evidence of bias. I cannot answer this question for the overall assignment of outcome scores, as the process for assigning scores is not transparent. These scores are the result of professional judgments about the influence and relative importance of the various factors influencing long term projections of habitat conditions that might support well distributed populations of each species. Without an explicit description of the various influences on habitat conditions and how these influences interact to yield final likelihoods, it is impossible for an outside reviewer to judge the outcomes against the relevant literature and against the projected trends in key habitat attributes.

Question 3. Was uncertainty and risk acknowledged, adequately displayed, and appropriately incorporated in alternatives and analyses of consequences?

The presentation of the habitat projections and environmental outcomes are adequately displayed and appropriately incorporated in Chapter 3 and forms the basis for the environmental consequences of the alternatives. Thus, I believe risk (to species viability) is presented reasonably thoroughly. The presentation of uncertainty is in projected outcomes is less thorough. The introductory paragraphs in section 4 contain a discussion of some of the major sources of uncertainty and describe the proper interpretation of the outcomes in light of these uncertainties. The narratives for many of the species contain paragraphs on sources of uncertainty. I recommend adding a section on uncertainty to each of the narratives where this discussion is lacking. I am not sure what else could be done to augment presentation of uncertainty in the analysis of consequences, except perhaps to discuss the spread of likelihoods among the outcome classes as an addition to the narrative descriptions of the environmental and population outcomes.

Question 4. Are the projected consequences of management actions consistent with scientific information?

I have no basis to fully judge the answer to this question. The literature reviews develop a basis for proposed linkages between key habitat components and species responses. Projected consequences of management action on these habitat components seem consistent with the information presented. However, I suspect the "bottom line" for evaluation of viability will be the outcome scores for each vulnerable species. The outcome scores are assigned by one expert or, in some cases, by panels of experts. It is not clear who conducted these evaluations. In some cases, it is not stated whether a single person assigned outcome scores or whether a panel was convened. I recommend a footnote disclosing the source of the outcome scores. On a more fundamental level, however, I am troubled by the lack of transparency in the outcome scoring process. For the evaluation of alternatives in the ICBEMP, the expert panel process was replaced with a Bayesian Belief Network (BBN) model that yielded likelihood scores for the same set of 5 environmental and population outcomes. In that case, the BBN models provided a transparent process revealing the exact thinking that led to the projected outcomes. I am concerned that a similar process was not followed in this evaluation, now that the methods for BBN models have been published. Panel evaluations have certainly passed the court process (FEMAT) and have been validated as within agency discretion. But now that better methods are available, challenges to the process may succeed. I am aware of the shortage of time and personnel and the fact that application of BBN or similar models may seem onerous. But such modeling can be done at a broad scale as a way of summarizing broad scale data. It may not be necessary to duplicate the watershed-level modeling done for ICBEMP. The population outcome models of IDBEMP can be constructed and run using already existing information and data.

Other comments - Monitoring and adaptive management

Appendix E contains a remarkably thorough monitoring plan for terrestrial species. Monitoring is essential to the adaptive management process, and adaptive management is proposed as the process for dealing with uncertainty in the viability assessments. However, the proposed monitoring program is overly ambitious in that I doubt that the agency would be willing to fund the work to complete the proposed components at a level of effort necessary to yield reliable results. Assuming I am correct that funding will not permit implementation of the full proposal, choices will need to be made. I recommend the addition of some ranking criteria to identify the most important components – to prioritize the long list of monitoring questions and components. Recognition of the likelihood of reductions in this menu of monitoring activities will help skeptics believe that a serious attempt will be undertaken to implement a realistic set of monitoring actions. In addition, the agency should not promise more than it can deliver. As we saw from the court rulings from the Northwest Forest Plan, a judge will hold the agency accountable for the monitoring work specified in the plan. Failure to carry out that monitoring may very well lead to a court-imposed injunction against any activity in the plan. Adaptive management requires a commitment to use the information derived

from the monitoring plan. Hopefully, the final documents will specify institutional mechanisms to incorporate monitoring information and respond accordingly.

Species Viability – Reviewer's Comments from Jim Shevock:

On November 13th, I participated on the Science Consistency Check. I focused on the issues of plant biodiversity, particularly how the alternatives provide for the conservation of rare, sensitive, and endangered species. I also gave special attention to special plant habitat components such as bogs and fens. I also evaluated how the alternatives will provide for species viability of cryptogamic organisms such as bryophytes (mosses, liverworts and hornworts) and lichens for which little information in the Sierra is documented. While complete inventories are lacking across the Sierra Nevada for these taxonomic groups, we do have enough information at this time to evaluate rarity, the need for conservation and their contribution toward ecosystem function.

One of the interesting features of the alternatives displayed in the DEIS for the Sierra Framework was the realization that several alternatives were developed from outside parties and modeled by the Forest Service as best as possible. When it comes to the various approaches to provide for biodiversity and species viability, it is not easy to evaluate the differences among the alternatives because the protective features are not additive. In most NEPA documents, alternatives generally have a minimum-level approach or standards and guidelines common to all alternatives. Each specific alternative may also have other components to provide for either a greater level of protection or provide for additional standards as a way to reduce the risk toward species viability.

In my view of the alternatives, it is very difficult to evaluate which may provide the best safety net for species viability. Several alternatives have predictive levels of uncertainty embedded in them. The scale by which these components of biodiversity occur on the landscape are not capable of being tracked directly through the alternatives as designed or the levels of modeling available. Clearly the timing, intensity and frequency of several of the proposed activities (primarily in fuels, grazing and timber management) could have significant impacts on plant biodiversity components regardless of the alternative selected. Considering the difficulty in assessing the risk to species viability of plants and lichens between the alternatives, I would suggest, as a minimum, that a specific standard be added to the FEIS, the selected alternative and ROD to ensure plant species and habitat viability is a priority at the project level. Such a standard would reduce the potential risk to these rare components across Sierran forests. This will be addressed further below.

Was the breath of available scientific information used?

I view the literature and plant conservation science utilized for developing Appendix R: Assessment of Species Vulnerability and Prioritization to be well done and I concur with the vulnerability ratings for the plant components.

Was the scientific information interpreted accurately and without bias?

Yes, I believe that the scientific information available has been accurately interpreted for botanical resources.

Was uncertainty and risk acknowledged, adequately displayed, and appropriately incorporated in alternatives and analysis of consequences?

As mentioned above, this is the area where the various alternatives do not provide enough assurance that rare plant habitats and their species components will be adequately protected. The areas where these taxa reside on the landscape are just too small for modeling purposes. In addition, some of the conservation approaches described for the riparian and aquatic areas of the forests leaves some room for doubt whether they will be affective to ensure that no plant species on the forests becomes locally extirpated at either a forest or watershed level. My largest concern is with the standards related to grazing in riparian and aquatic areas. Based on my field studies across Sierran forests, the grazing standards currently employed do not provide for or ensure a high degree of protection and conservation for the rarest plant components in the Sierra Nevada. When one considers that bogs, fens, and perennially wet meadows are only a small subset of riparian systems in the Sierra (less than 2 percent of the landscape), additional safeguards must be put in place to maintain these components of biodiversity which are also considerably species rich environments. Stubble height is a poor proxy for ecosystem health or to track the impacts of grazing on either rare species or biodiversity in meadow and bog-like habitats. Stubble height or amount of exposed soil in meadow systems (if even monitored) occurs after the damage has been done for the grazing season.

While the Forest Service clearly views that forest trees have other values to society besides utilitarian ones based on no harvest in wilderness, research natural areas etc., there is not a single provision in the Sierra Framework EIS that would similarly provide for conservation of meadow and riparian vegetation. Each blade of grass is viewed solely for its consumptive value. Except for only a handful of areas across the Sierra where an allotment has been retired over time, every other hectare is impacted directly by grazing including wilderness areas, research natural areas, etc. None of these retired allotments was developed with conservation biology in mind. However, there is a need to systematically look at future opportunities to either restrict or retire allotments in key biodiversity areas when an allotment becomes vacant in the future.

Few meadows in the mixed conifer to lodgepole pine zone in the Sierra, even in designated wilderness, are in good shape. Head-cuts are common, non-native weed infestation is on the rise, and impacts by cattle trampling and soil compaction in wet meadows, especially bogs, is quite damaging. Nonetheless, these systems can recover with proper management and time. Bryophyte diversity in several meadows in Sequoia and Kings Canyon National Parks are showing signs of improvement with reduced grazing pressures (reduced now to stock use in the parks). The bryophytes are in my view an excellent monitoring element to track grazing impacts and ecological improvements. While many rhizome-forming plants (such as grasses, sedges, and rushes) have the

capability to repair damage caused by trampling, the bryophytes do not. Bryophytes lack roots. They are laying on top of the meadow like a protective blanket but not actually attached to it. They provide significant stability to the meadow and water transport through these systems. In heavily grazed meadow systems, it is the bryophytes that are the first to be either degraded or have selected bryophyte extirpations due to altered hydrologic patterns caused primarily by grazing. Two genera of mosses (*Sphagnum* and *Meesia*) are found today in the Sierra in only perennially wet meadows that still have most of their functions intact. For this reason, only a smaller subset of Sierran meadows still have these genera present. *Messia triquetra* and *Messia uliginosa* are identified as Forest Service sensitive species for this reason. Both *Meesia* and *Sphagnum* at the level of genus are easy to identify in the field at any time of the year (except while under snow) by both botanists and range cons and should be the taxa used to evaluate the health of Sierran meadow systems. As a minimum to provide a level of conservation and assure that these rare elements and habitats are protected in the FEIS, there should be a network of meadows, bogs and fens at the watershed and forest level that are fenced from cattle grazing to insure that meadow biodiversity components are conserved. In some cases, it can even be a portion of a meadow as long as all of the ecological processes remain intact (spring/seep flows across the meadow). The forest botanists actively involved in developing the Sierra Framework can develop such a reasonable and protective standard that would not adversely affect the existing permittee's operation, especially if the entire allotment were to be properly managed.

Are the projected consequences of management actions consistent with scientific information?

Generally, the alternatives do project the consequences at the landscape scale. Nonetheless, as referenced above, the rarest elements of biodiversity still need to be addressed more specifically and directly. This can be accomplished by a few additional explicit standards and guidelines that can be incorporated into the FEIS and ROD.

Appendix VI.
Reviewer Comments on Fire and Fuels

Fire and Fuels -- Reviewer Comments from David Weise:

a. (4) Have we adequately portrayed existing hazard and risk across the national forests?

It is not possible to tell how hazard and risk were determined across the national forests with the information provided. Appendix G refers to a "Analysis of Large Fire History by Forest by Vegetation Type" and several chapters refer to a Table 4.1b that seems to summarize this information. How was historic fire severity determined? The map that was apparently produced by this analysis is not part of either CD that was provided (the DEIS or the DFEIS). Once this information is available, it will be possible to assess the adequacy of the approach that was used to portray hazard and risk.

From the brief descriptions that were given, it seems as if several of the components necessary to evaluate risk (historical fire occurrence analysis, location of wildland/urban interface, current fuel conditions, location of ignitions (lightning, human)) have been considered. Reference is made to the McKelvey/Busse analysis in SNEP in which fire occurrence was correlated with elevation and perhaps precipitation. I can't tell if weather and climate have been factored in to the hazard/risk analysis. A climatic analysis using a greater period than 20-25 years to identify "dry", "critically dry", etc. years coupled with fire occurrence/size information will serve to identify the causal factors of the hazard and identify if fuels or weather are the more critical factor. 7-8 years of the analysis period included a prolonged drought.

Because of the lack of information, I cannot determine if existing information was interpreted accurately and without bias, or if uncertainty was addressed.

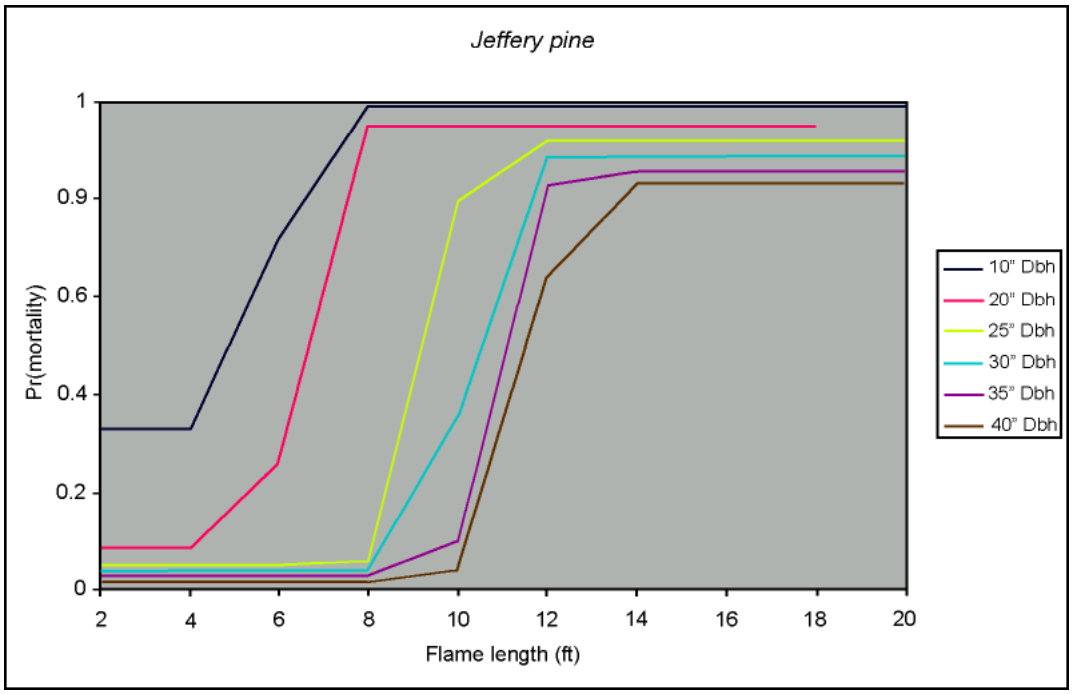
b. (3) Have we adequately considered the influence of fire as a disturbance force affecting the landscape?

While it is not expressly stated, it seems that an underlying assumption of the analysis is that when wildfire occurs in these altered forest conditions, it will occur as a significant, destructive force. This was the perception that existed in 1988 when Yellowstone NP burned and this perception or tone is prevalent in many of the policy documents that now exist. In the case of Yellowstone NP, the perception was quite different from the reality of the disturbance those several fires caused. In the case of lodgepole pine, this type of fire disturbance was necessary and the resulting ecosystem responses have been perceived as beneficial. Numerous articles in the scientific literature describe the changes that have resulted in the Yellowstone NP ecosystem as a result of those "catastrophic" fires.

I find very little reference to any of the scientific literature relating to fire as a disturbance factor in the Sierra Nevada ecosystem. While a great deal of effort was invested in the Sierra Nevada Ecosystem Project and much of the literature and assessment is contained in those documents, the salient scientific literature should be included in this document. I would suggest that the quality (perceived) of the refereed literature might be higher than the perceived quality of the SNEP reports. Outright inclusion of the pertinent fire chapters from SNEP with inclusion of recently published literature and additional literature specific to this EIS process should result in use of the breadth of literature and accurate interpretation.

Because the "Large Fire Analysis…" is unavailable to evaluate, it is not possible to assess if uncertainty and risk are adequately acknowledged, displayed, and incorporated into Alternatives and Analysis of Consequences. A presumption that runs through many of the alternatives is that they will reduce the frequency of wildfire. A statement is made that there are several instances in which the effectiveness of the proposed fuel treatments have been effective. To my knowledge, there is little, if any, published data indicating that fuel treatments have altered wildfire occurrence and/or character. There has been anecdotal testimony to that effect, though. There is currently a study being conducted by Dr. Phil Omi at Colorado State University that is attempting to quantitatively describe the effects of previous fuel treatments on wildfire behavior and effects. Preliminary results of this work may be available and may serve as an unrefereed reference.

The limitations of using FOFEM to estimate postfire tree mortality as input into SPECTRUM needs to be described. It appears from reading the literature associated with FOFEM 4.0 that most of the data used to develop the tree mortality functions came from the Intermountain West and perhaps the Pacific Northwest. While the Sierra Nevada and these areas have tree species in common, little if any data from the Sierra Nevada were used to either develop the equations or test the results. Because of climatic differences, each species may have developed different survival strategies for fire. In a similar vein, the equations used to estimate postfire mortality are highly sensitive to incremental changes in flame length. Observe the relatively steep slopes in the graph below that estimates probability of mortality as a function of flame length for several different sized trees.



c. (4) Have we adequately developed strategies that permit the reintroduction of fire as a natural ecosystem process?

If the objective of fire reintroduction is to simulate fire as it occurred prior to European effects, I believe that many of the alternatives will accomplish this. However, I don't believe that the "ecofire" strategy will initially emulate the pre-settlement fire regime. Recent research by Sackett and Haase is suggesting that mechanical removal of understory and ladder fuels might be necessary prior to fire reintroduction since repeated prescribed fire in ponderosa pine in AZ has not successfully thinned these suppressed trees. Their work also suggests that fire reintroduction without removal of the large accumulation of litter fuels found in some forest types prior to fire's reintroduction may result in higher than normal mortality of large, apparently "fire-resistant" trees even from relatively low intensity initial fires. These results are restricted to ponderosa pine in Arizona, but may be one of the causes of mortality of large sugar pines subsequent to the reintroduction of low intensity fire in giant sequoia groves at Sequoia-Kings Canyon NPs in the 1960s. Preisler, Sackett and Haase published a model in 1999 that might possibly be used to estimate risk of mortality following fire reintroduction.

d. (3) Have we developed a range of landscape-scale strategies to provide choices for dealing with forest fuel conditions and values at risk?

As noted previously, many of the treatments are assumed to have an effect on wildfire occurrence and thus have an effect on values at risk. In order to have an effect on wildfire occurrence, one of two things must happen – fuels must be removed or rendered noncombustible or ignition occurrence must be reduced. None of the treatments will alter lightning ignition potential and retention of large, dead woody material (either coarse

woody debris or snags) may actually increase the probability of a successful lightning ignition. The treatments don't appear to address reducing the risk of human-caused ignitions. The treatments probably will have an effect on wildfire behavior and make it possible for fire suppression activities to take place in areas where fuel levels have been reduced by one of the strategies. Reducing the heat release from wildfires will certainly reduce or change the ecosystem effects; however, risk has not really been quantified in any of the analyses I read.

Recent modeling work by Jack Cohen (FS Research, Missoula) suggests that the likelihood that a wildland fire will ignite a home in the interface by radiant heating from flames alone is small and that the incident heat flux of large wildland flames greater than 30' from a structure is insufficient to cause ignition. Structure ignition by flaming brands can occur over larger distances. His postfire analysis of the Cerro Grande fire suggests that many structures were lost because a low intensity surface fire spreading in litter fuels ignited accumulated fuels (woodpiles, decks, etc.) adjacent to the structures. He recommends that structure loss from wildland fire can be reduced by changing construction requirements to reduce flammability of homes located in the interface.

Why were no mechanical treatments (codes 20, 21) included as possible alternatives? Like many of the considered treatments, these 2 treatments would alter wildland fire behavior by reducing total heat release (fuel would be gone). Rate of spread might be increased if there is a sufficient influx of fine grasses.

e. (4) Have we adequately portrayed the benefits and liabilities of using prescribed fire and mechanical treatments as management tools?

With the exception of large tree mortality and smoke emissions, many of the benefits and liabilities of Rx fire and mechanical treatments appear to be addressed. As noted above, use of prescribed fire without removal of large accumulated forest floor materials may result in mortality of large trees that is unacceptable. As with previous questions, it is difficult to assess if the breadth of scientific information was used. The process whereby smoke emissions were calculated and determined is not adequately described. I would suggest using the FETM model to evaluate the benefits and liabilities of the various treatments with regard to smoke. This model will identify the effects of the treatments on wildfire smoke emissions and total emissions. Uncertainty of smoke emissions could be estimated by multiplying the emission factor error(s), the fuel acreage error(s), and fire acreage error(s). The projected consequences of the prescribed fire treatments with regard to large tree retention are probably flawed given the previous discussion.

(1) Have we adequately portrayed the trade-off between mechanical and prescribed fire fuel treatments?

No. As mentioned in **e**, I suggest that the FETM model be used as an independent assessment of the impacts of the fuel treatments on both smoke, wildfire occurrence, and vegetation distribution. FETM can be run out 100 years to determine at which point prescribed fire emissions will reduce wildfire emissions.

f. (1) Have we adequately displayed an instructive set of scenarios about fire loss possibilities in the future?

I was unable to find a concise listing or maps of projected fire losses in the future. Here again, FETM could provide a nonspatial estimation of treatment effects on vegetation which could then be used to infer effects on other resources. Since FETM is a simulation tool, it could be used to estimate uncertainty of the outcomes. The stand visualizations provide a qualitative impact of the treatments on various stands.

Fire and Fuels – Reviewer's Comments from Jan W. van Wagtendonk:

In my analysis, I have tried to answer the four process issues for each of the seven questions in the fire and fuels area.

A. Existing hazard and risk:

I found that the *breadth of available science* was used, but that there were some references that could have been included. Specifically, some of the assessments that have resulted from CDF's FRAP would have added to the hazard and risk analysis.

The scientific information that was presented was *interpreted accurately and without bias*.

Risks and uncertainties surrounding the scientific information were obliquely mentioned. Regarding risk, there needs to be a paragraph added that defines the risk. This especially true for the risk of fire. The traditional fire term defines risk as the probability of a fire start. In the EIS, risk appears to be defined as the probability of having a fire damage something of value. With uncertainty, risk seems to refer to the probability of making an erroneous decision based on the scientific information.

The *projected consequences* of management actions were consistent with the scientific information.

B. Influence of fire as an ecological force:

Additional references should have been included in this section to expand the *breadth of available science* that was used. Specifically, the work of Harold Biswell, Willis Wagener, and Bruce Kilgore should be cited. The term "disturbance" should not be used in reference to the natural role of fire. That is a "dendro-centric" view of things. Natural fire is an ecological force; fire exclusion is a disturbance.

The scientific information that was presented was *interpreted accurately and without bias*.

Risks and uncertainties were adequately addressed.

The *projected consequences* of management actions were consistent with the scientific information.

C. Reintroduction of fire:

The change in the EIS regarding the reintroduction of fire was so significantly better than the RDEIS that it is difficult to get picky about the *breadth of available science*. However, it would be useful to refer

to the great strides that have been made in the national parks and the national forests over the past two decades.

The scientific information that was presented was *interpreted accurately and without bias*.

Risks and uncertainties were adequately addressed.

The *projected consequences* of management actions were consistent with the scientific information.

D. Landscape-scale strategies:

The *breadth of available science* was adequate.

The scientific information that was presented was *interpreted accurately and without bias*.

Risks and uncertainties were adequately addressed.

The *projected consequences* of management actions were consistent with the scientific information.

E. Benefits and liabilities of prescribed fire:

The *breadth of available science* did not include important references to the literature on prescribed fire. Important work, especially that done in the national parks, was not cited. Again, Bruce Kilgore's work, Dave Parsons, Nate Stephenson's, and if can be so modest, a lot of mine, were not even mentioned.

There was one instance where I feel that *bias might have entered into the interpretation of the scientific information.* On page 250 of the section 4 (Sierra Nevada Species) of Chapter 3 (Affected Environment and Environmental Consequences) reference is made to the reasonable hypothesis that historic light burns probably did not result in California spotted owl territory abandonment. It goes on to say that no study has been conducted to address the effects of fuel treatments on spotted owl, occupancy, survival, and reproduction in PACS. It later cites (Weatherspoon et al. 1992) but fails to mention that that reference includes information stating that eight active spotted owl nests sites were in areas that had been burned with wildland use fires during the previous eight years. This omission biases the presentation.

Risks and uncertainties were adequately addressed.

Based on the above comment, I feel that the *projected consequences* of management actions were not entirely consistent with the scientific information.

F. Prescribed fire and mechanical treatment trade-offs:

Although the *breadth of available science* on trade-offs between prescribed burning and mechanical treatments is sparse, a fuller discussion of one specific citation should have been included; i.e., van Wagtendonk (1996). Although cited, there was no discussion on the results and conclusion of the modeling work.

Not so much a *bias in interpretation* but a misinterpretation by omission occurs if a citation is listed but not discussed.

Risks and uncertainties were adequately addressed.

The *projected consequences* of management actions were consistent with the scientific information.

G. Future fire loss possibilities:

The *breadth of scientific information* was adequate.

An *interpretation* error occurs when future projections of loss are based on historical number of acres burned if the severity of the burn is not considered. For example, Table 3 on page 3-159 indicates that approximately 30 percent of the acres burned with non lethal severity fire. If one compares the fire behavior and fire effects of such a fire to the prescribed fire treatment, they are virtually identical. The assumptions on future trends and fire frequency (pages 3-181 to 183) assumes that habitat lost to fire will increase if the projection is based on the 1986-1996 fire period. If, however, that number of annual acres burned is reduced by 30 percent, that habitat acres would actually increase not decrease. The discussion should caution the reader about these projections.

Based on the above comment, r*isks and uncertainties* were not adequately addressed.

Similarly, the *projected consequences* of management actions were not completely consistent with the scientific information.

Suggested references:

Parsons, D. J., and J. W. van Wagtendonk. 1996. Fire research and management in the Sierra Nevada national parks. P. 25-48 *in:* Halvorson, W., and G. E. Davis (Eds.). Science and ecosystem management in the national parks. Univ. Arizona Press, Tucson. 364 p.

van Wagtendonk, J. W. 1996. Use of a deterministic fire growth model to test fuel treatments. *In:* Sierra Nevada Ecosystem Project: Final report to Congress, Volume II, Chapter 43. Univ. Calif., Davis, Wildland Resources Center Rep. 37. 1528 p.

Weatherspoon, C. P., S. J. Husari, and J. W. van Wagtendonk. 1992. Fire and fuels management in relation to owl habitat in forests in the Sierra Nevada and southern California. P. 247-260 *in:* Verner, J., K. S. McKelvey, B. R. Noon, R. J. Gutierrez, G. I. Gould, and T. W. Beck (Tech. Coords.). The California spotted owl: a technical assessment of its current status. USDA, Forest Service Gen. Tech. Rep. PSW-GTR-133. 285 p.

van Wagtendonk, J. W. 1986. The role of fire in the Yosemite Wilderness. P. 2-9 *in:* Proc. Nat'l Wilderness Res. Conf.: Current Res. USDA, For. Serv. Gen. Tech. Rep. INT-212. 553 p.

van Wagtendonk, J. W. 1984. Fire suppression effects on fuels and succession in short fire interval wilderness ecosystems. P. 119-126 *in:* Proc. Symp. and Workshop on Wilderness Fire. USDA, For. Serv. Gen. Tech. Rep. INT-182. 424 p.

Fire and Fuels – Reviewer Comments from Greg Greenwood:

My three observations related to fire and fuels:

1) The FEIS does not disclose the results of sensitivity analysis performed on the major sources of uncertainty in the modeling of alternatives, yet a choice between the alternatives requires such analysis. The team has not specified the principal sources of uncertainty in the analysis, though every discussion emphasizes such parameters: e.g. the percentage of a watershed treated before the Finney effect kicks in, stand density index and its effects on mortality, future trends in black acres, etc. While it is reasonable to begin scenarioing with the most expected values for these parameters, a robust analysis would quantify the results of a given alternative, given other plausible values for the parameters. It would as well consider situations other than "mean conditions" as relevant to a decision: this is particularly important in fire where rare but severe events are important to system trajectory. The modeling framework is indeed far better than what has been used in the past, but it still needs to be deployed in a manner that accurately mirrors our understanding of the uncertainties in both the internal interactions and the future external environment if it is to adequately inform decision makers.

2) There is deep disconnect between the focused appraisal in the FEIS of what we know and what don't know with respect to fire and fuels as well as how those uncertainties may play out in decision space, and the overly broad approach to fire and fuels in the adaptive management section. If the winnowing of what's important from what isn't, of what's known well from that which is not (e.g. fire behavior in riparian areas vs. on upland slopes) performed by the technical team isn't immediately converted into a proposed adaptive management scheme, then the adaptive management portion of the decision is likely be very inefficient at advancing scientific understanding of the Sierra that actually informs and improves management.

3) The FEIS does not fully disclose the institutional requirements of the various fire and fuels strategies. These requirements are no less scientific than biological aspects of the ecosystem; they are just written different kinds of observers. For instance an alternative that proposes a great increase in prescribed fire ought to also note that for such a strategy to work, the fire service will probably require an increase in the number of trained personnel, greater suppression resource availability, more pre-project planning with regulatory agencies to ensure that burn windows don't further shrink, etc., etc. These requirements are foreseeable, quantifiable, and probably repeatable in that different observers would likely to come to similar conclusions.

Appendix VII.

Reviewers' Comments
Old Forest Conservation

Old Forest Conservation – Reviewer Comments from Michael Barbour:

1
PREFATORY COMMENTS

I've embedded my comments under the four-question format. Sometimes a comment could have been placed under more than one question; in such cases the question I chose to put the comment under was chosen more for convenience than for logic. Although the review team agreed that numerical ratings were not necessary, I have chosen to use them. In this system, a 5 means an unambiguous "yes" answer to the question; a 4 means the answer is "a conditional yes." In the latter case, I have briefly indicated what changes in the report would raise my rating to a 5.

At the end of comments specific to old forest are some additional comments on related topics or text that I felt were important enough to include.

I recognized the draft nature of the material to review, so I have not included any comments about typographical errors, missing tables, or missing text sections. I also understood the limitations of time that the framework staff were working under, so I was not looking for an encyclopedic product that contained every possible scrap of data and all possible interpretations of the data.

OLD FOREST COMMENTS

I. Was the breadth of available scientific information used?

A few important documents that describe major forest communities in the Sierra Nevada were not cited or used in the text. They have important quantitative and qualitative information about old-forest structure and composition in the lower and upper montane zones. They are:

D.A. Potter. 1998. Forested communities of the upper montane in the central and southern Sierra Nevada. USDA Forest Service, PSW-GTR-169, Albany, CA.

J.A. Fites. 1993. Ecological guide to mixed conifer plant associations, northern Sierra Nevada and southern Cascades. USDA Forest Service, R5-ECOL-TP-001, Placerville, CA.

F.W. Davis and D.M. Stoms. 1996. Sierran vegetation: a gap analysis, pp 671-707 in: Sierra Nevada Ecosystem Project, final report to Congress, vol II, Centers for Water and Wildland Resources, University of California, Davis.

A.E. Wieslander. 1946. Forest areas, timber volumes, and vegetation types in California. Forest Survey Release No. 4, California Forest and Range Experiment Station, Berkeley.

<u>Rating of this question = 4. It can be raised to 5 by adding the references and devoting a paragraph of text to explaining the contributions of each.</u>

II. Was the available scientific information interpreted accurately and without bias?

The interpretations seemed appropriate and accurate. There is a strong bias in the source of data used most consistently, which is the Franklin and Fites-Kaufmann assessment of late- successional forests, as published in the 1996 SNEP report. Bias is not necessary a bad trait--it's based on an individual's knowledge about system--as opposed to prejudice.

There are two problems with this particular bias. One is that the accuracy of the patches and polygons recognized in the SNEP process is only modest. According to the quality assessment of the old forest maps (written by P.G. Langley and published in the 1996 SNEP report), the accuracy of patch assignments (fine scale) averaged 44% and the accuracy of polygon assignments (averages of many patches, thus a coarser scale) averaged 60%. Langley also pointed out that a network of map patches determined from FIA plots on the ground differed significantly ($p = 0.05$) from patches mapped by SNEP.

The second problem is that the SNEP approach does not map pristine, never-entered stands. Old forests are defined by a certain density of trees with dbh greater than some critical value, combined with canopy cover classes. Such stands can include forests that have been entered and selectively logged, changing the age structure of the stand and modifying the understory, soil compaction, litter cover, and the pattern of regeneration. Because of the scale emphasized by SNEP, polygons are of a large size (500-5000 acres) and they are heterogeneous. If part of one polygon is a forest with many old-forest attributes, but it lies in a larger matrix of forest with few old-forest attributes, the polygon will be labeled by the average value, as weighted by area. Small patches of old forest are lost from the map, and the distribution of old forest appears to be smaller than it is. In the other direction, a polygon may receive a high old-forest rating even if it has been entered in the past in its entirety and no part of the polygon contains pristine old forest. In this case, the distribution of old forests may appear to be greater than it is.

It may be important, in future management that follows one of the eight options, to apply different techniques for fuel reduction in a pristine old forest stand, compared to that used in a previously entered old forest stand. Thinning might be a poor choice compared to prescribed fire, because fire will have less of an effect on soil compaction and soil surface disturbance than mechanical or hand thinning. The fraction of forest area that still contain pristine old forest is so small (I would estimate <5%) is so small that such decision making will not have to be done often--but the patches are so important as representatives of the pre-contact ecosystem that they should be treated on a case-by-case basis, as uniquely as stands with rare and endangered species are treated. Small un-entered stands are not necessarily too small to be functional, sustainable ecosystems. As described in Chapter 3, some old forest organisms do not require an extensive, contiguous expanse of old forest. We do not know, at this time, what the minimal functional area might be for a given old- forest type.

I would like to see more attention in the text to FIA plots as aids to defining old forest and to mapping the distribution of old forest. Thousands of plots exist, characterizing virtually every forested polygon in the Sierra Nevada. Furthermore, the FIA data have recently been entered into a convenient computer format by Dr. Jim Bouldin, a Framework staff member (see J.R. Bouldin, 2000, Twentieth century changes in forests of the Sierra Nevada, California, PhD dissertation, University of California, Davis). Dr. Bouldin has also put the 1930s VTM plot data (see Weislander reference cited in part I) into a similar format, and these data could be interpreted to show the fraction of the landscape at that time that was in old-forest condition.

Incidentally, the text in Chapter 3, page 72 raises an issue that FIA plots "undersample" the Sierra Nevada because their collective area is only 0.1% of total area. In my opinion, the sampling of wildland vegetation seldom includes more than that percent of an area being examined.

Another potential source of information about the nature and distribution of old forest in the historic past is general land office (GLO) surveys that included notes on the identity and size of witness trees at section corners. I know that Dr. Fites-Kaufman is already using this technique in the Lake Tahoe watershed, and that it could be used in many other parts of the Sierra Nevada. Although the data have not

yet been compiled and analyzed, I expect that the results will be in hand within 2-3 yr and that they will give us valuable help in reconstructing past landscapes. This approach needs to be mentioned in the text.

I rate the answer as 4. It could be raised to 5 by adding text that more fully explains the limitations of the SNEP classification/mapping system, and by encouraging future land- use managers to use FIA plots as a check of (and where necessary as a correction to) SNEP maps of old forest in their particular area.

III. Were the risks and uncertainties surrounding the scientific information acknowledged and adequately displayed?

I think the projections of increased old forest area that would result in 50+ yr according to the 8 options (eg, Chapter 3, p 47, Fig. 3.1h) needs tempering language that reminds the reader that old forest is being defined mainly on the number of trees per hectare with a dbh greater than a critical value. Recall that the definition is broad enough to include stands that have been partially harvested in the recent past, stands that still show soil surface disturbance, possible soil compaction, and possible patterns of tree regeneration that were disturbance-caused. Will the 50+ yr that moves a previously non-old-forest stand into the old-forest category be sufficient time for the soils to recover from disturbance? Is this amount of time sufficient to reduce or increase the biomass of coarse woody debris on the forest floor back to a level one might expect in an unentered, pristine old-forest stand?

There is a degree of uncertainty associated with predicting seral forest response to thinning and burning. Chapter 3, p 96, refers to this uncertainty, but it does not give the reader hope that we shall soon know more. At Teakettle Experimental Forest, a scientific, replicated experiment has just begun, to examine the differential effects of thinning and prescribed fire on such ecosystem functions as soil and plant nutrient status, water infiltration, tree growth, and biodiversity. This experiment, overseen by Dr. Malcolm North of the Forest Service, will be interpretable within half a dozen years into the future. This experiment should be at least briefly mentioned as a source of decreasing uncertainty relatively soon.

Another aspect of unaddressed uncertainty is the impact of thinning and prescribed fire on soil erosion and soil permiability to water. Chapter 3, page 135, states that "Sierra Nevada landscapes have relatively low natural surface erosion rates." But I am not aware of any published measures of soil erosion rates on slopes of various steepness and as further influenced by mechanical disturbance during the process of thinning or by the effect of high temperatures on the depth and continuity of a water repellent layer in the soil or duff. Chapter 3, pp 258 and following, does mention the impact of machinery on soil compaction but not on erosion. The impact of fire on erosion is limited to a brief statement on p. 261 that only pertains to high intensity crown fires.

The issue of soil erosion and water runoff is important to the functioning of wetlands (meadows and riparian stringers) that are situated downslope from forests managed by thinning or fire.

Finally, an uncertainty about the length of time management must go on for, in order to detect vegetation change, is minimized in Appendix E, p 46. The report states: "The results from monitoring silvicultural and mechanical treatments in old forest stands will rapidly provide information to forest managers about the effectiveness of current strategies...[thus]...managers can make course corrections quickly." I'm sure that mortality can be assessed quickly, but the effect of the mortality and treatment on forest health will be much slower to recognize. It is not clear from the report what will be monitored in the forest, as surrogates for health. A recent watershed assessment for the Lake Tahoe watershed (see D. Murphy and C.M. Knopp (eds.), 2000, The Lake Tahoe watershed assessment, USDA Forest Service, LTBMU, South Shore, CA) was inconclusive in its search for surrogates for forest change that could be easily, inexpensively, and robustly monitored and which in addition would lead to unequivocal conclusions within a several-yr time frame.

I rate the answer as 4. It could be raised to a 5 simply by more explicitly recognizing the uncertainties described above in a few paragraphs the text.

IV. Are the projected consequences of management actions consistent with scientific information?

I think some of the answer has already been placed under other questions. For example, projections of increases in old-forest area over time might better be tempered by separating entered old forest from pristine unentered forest. However, in general the answer is "yes." I rate the answer as 5.

COMMENTS ON OTHER TOPICS

Chapter 1 (Summary of issues and alternatives) p 1 states that all alternatives aim to "sustain old forest ecosystems." In fact, every alternative aims to increase the amount and distribution of old forest, in addition to sustaining old forest (see Chapter 3, p 7). Therefore this early statement needs to be amended to "increase and sustain."

Chapter/part 3.1, p 1, 8 lines from bottom: The vegetation types in the Sierra today have not evolved under a specific fire regime, because there is no evidence that vegetation evolves--only populations seem to. Suggest the sentence be changed to: "The vegetation types in the Sierra today have experienced various fire regimes for thousands of years."

Chapter/part 3.1, p 2, first sentence of second paragraph over states the California case. Suggest the sentence be changed to: "The Sierra Nevada landscape is comprised of a patchwork of...[and continue with the second sentence]."

Chapter/part 3.1, p 2, farther down in second paragraph, the definition of a plant community traditionally and formally includes composition, structure, and habitat. Suggest changing sentence to replace "function" with "habitat." Ditto for start of next sentence.

Chapter/part 3.1, p 3, fourth line down, suggest replacing "classifying" with "mapping." The two are quite distinct, and mapping is clearly the proper word here.

Chapter/part 3.1, p 36, last paragraph: Chaparral is not found almost exclusively in California. Petran chaparral is common in the Rocky Mountains; true, different species, but the vegetation type is still called chaparral. Suggest changing sentence to say that chaparral ecosystems "are particularly abundant in California." In addition, I recommend that the reader briefly be apprised about the two forms of chaparral that occur in the Sierra Nevada: foothill chaparral with chamise and montane chaparral without it and with different species of Arctostaphylos and Ceanothus than in foothills. Another difference is the possibility of montane chaparral being seral to forest; not so with foothill chaparral.

Chapter/part 3.1, p 37, third paragraph: Reader should be briefly apprised that there are two kinds of grassland, valley grassland and foothill grassland. Although bunch grasses have largely been eliminated from valley grassland, they still contribute a significant amount of cover (though reduced from pre-contact days) in foothill grassland.

Appendix E/part 11.2, p 121: There is no question concerning the effect of prescribed fire on erosion and soil permeability to water. Suggest adding "Question 5: Does the use of prescribed fire meet soil quality conditions for erosion and water percolation on forested slopes?" And below this, adding "Attributes: presence and depth of water repellant layer as indicated by water infiltration and runoff rates, soil porosity/bulk density, and soil loss."

Old Forest Conservation – Reviewer Comments from Frank Davis:

Thank you for the opportunity to participate in the FEIS Science Consistency Check. Although I believe the Science Consistency Check is a useful process, I am concerned that the team received the materials only a few days in advance and was given only a few hours to discuss each major theme. Furthermore, much of the background scientific work by the FEIS Team was not reported in the documents we reviewed (which themselves are still incomplete drafts). Obviously we can provide only a superficial consistency check of a large and complex analysis. It is important that our consistency check not be represented as more than it was.

1. Comments on "Old Forest Conservation".

I cannot claim any special expertise in late-seral Sierran forests, but I am familiar with SNEP's findings and am very familiar with the input vegetation data. My general impression is that the FEIS team has done a good job synthesizing the relevant information and addressing the broad range of concerns that have been raised regarding old forest conservation.

A. Was the breadth of available information used?

The FEIS Team has consulted the major sources of recent, readily available information on Sierran forests, notably FIA timber inventory plot data, R5 stand maps, SNEP data, GAP data and the SBI map. The nature and weaknesses of these sources is well-understood and described. The analysis depends heavily on the SNEP LSOG data and to a lesser extent the old growth map of the Sierra Biodiversity Institute to characterize the resource. The FIA plots and timber strata maps that were used extensively for modeling outcomes under alternative policies were apparently not used to characterize old forest distribution and extent. Some might see this de-coupling as a serious problem, and fuller explanation and justification is warranted. There was not much systematic use of historical information such as the VTM survey plots and maps and not much use of comparative information from nearby regions (e.g., Rich Minnich's analyses from the Transverse Ranges and Baja California). Such perspectives could be useful in thinking about historical reference conditions. In general, not much attention was paid to recent historical trends by subregion and causes of those trends. This information is important in evaluating future alternatives.

B. Was the available information interpreted accurately and without bias?

The analyses are generally well balanced. However, in my opinion all of the alternatives place disproportionate emphasis on forest structure, driven in large part by threat of catastrophic wildfire and the structural habitat requirements of a few vertebrate species of special concern. The forests are treated generically as CALVEG types, a level of simplification that subsumes systematic latitudinal and elevational variation in biotic composition and genetic stocks of both plants and animals. Some more specific description of this variation and appropriate caveats about any generic policies would seem advisable. I expect that some of this subregional and local variation was accounted for in more local analyses not reported here and that it will also factor more prominently in actual implementations. At any rate, there may be too much emphasis on producing and maintaining "generic" large conifers, with apparently less attention to genetic resources, hardwood and shrub components, and the herbaceous flora that contribute most of the floristic diversity and maintain many of the vertebrates and invertebrates in Sierran ecosystems.

The amount and distribution of old forest varies enormously depending on the scale of the information, and it is extremely important that the old forest analyses be as consistent and as explicit as possible with regard to data source and scale. The team has made a good-faith effort to characterize the mix of map data that was used. Nevertheless, it is difficult to evaluate some of the analyses because of the mixing of data sources of different spatial scales (e.g., mixing SNEP and SBI data) and the "oversampling" of course polygon data to finer grids (e.g., gridding LSOG polygons to 100m). In some analyses it appears that patch-level characteristics have been applied to entire SNEP polygons. The weighting scheme used to map and model old forest emphasis areas (Appendix B, Table B-2) strikes me as very ad hoc scoring and a dangerous way to mix information. For example, it involves double counting of some evidence (e.g., areas mapped by SNEP with high proportion of large trees plus ALSE areas (which were identified in part based

on patches with large trees)). The total commission error in distribution of old forest from combining all of the sources in Table B-2 could be considerable. Focalsum analysis of a 100 ha grid derived from SNEP LSOG polygons is also problematic.

The USFS uses 10% conifer cover as the threshold for classifying and mapping conifer types. This rule could lead to systematic bias in the way that the hardwood and shrub components of Westside forests (especially lower elevation Westside forests) are characterized and modeled in the forest and fire management studies.

C. Were the risks and uncertainties surrounding the scientific information interpreted accurately?

My reaction to the entire report is that the team understands the risks and uncertainties inherent in the data and information and that for the most part they have interpreted these risks and uncertainties accurately in a *qualitative* sense. There is very little quantitative analysis of error and uncertainty and relatively little sensitivity analysis reported (although I think much of this kind of work has been done). The findings are highly distilled and simplified for public presentation, and the magnitude of the uncertainty, especially that associated with the predicted outcomes from each of the alternatives, is not at all evident. This kind of uncertainty can be communicated by reporting ranges or deviations as well as means, etc.

Current mapping and inventory methods of the USFS based on plot sampling and satellite imagery have been designed to produce forest-level estimates of timber volume. This information is of relatively fine spatial detail and good locational accuracy but is thematically coarse and is not reliable when applied to individual stands. SNEP LSOG data notwithstanding, USFS forest inventory information has continued to serve as the basis for much of the spatial planning and modeling exercises and policy analyses underlying the EIS. These are applications for which the data were never intended. The uncertainty in any projections of stand structure and composition, fire behavior, or species habitats, based on this information is extremely high. This is not obvious in the presentation of the alternatives, where predicted averages are presented instead of ranges. Furthermore, the EIS gives no indication of concern for the substantial increase in the quality and amount of geospatial information that would be needed to actually implement and evaluate any of the alternatives.

Regarding the old forest analysis, it seemed to me that Langley's analysis for SNEP was more detailed than that of Session et al., and that the conclusions reached by Langley should be presented in greater detail and considered more fully in terms of the uncertainty of the LSOG information. Quantitative comparison of wildlife occurrence data to the various forest structural data would be helpful, as would quantitative comparison of R5 forest inventory maps to SNEP data.

D. Are the projected consequences of management actions consistent with scientific information?

I am not able to answer this question given the time available for review and the distilled nature of the presentation in the FEIS.

The five problem areas are very different in their nature, scope and significance for Sierran national forests. Three problem areas concern ecosystems and associated species (old forests, aquatic/riparian/meadow ecosystems, and lower Westside hardwood systems), one is a process (fire), and one is a specific set of species (noxious weeds). Although fire and weed invasion are processes that can cross ecosystem types, I found the disparate nature of the problem areas a distraction in evaluating alternatives. For example, isolating noxious plant species from fire and fuels decouples the establishment and spread of exotic plant and pathogen species from the management activities and ecological processes proposed by the different alternatives. To illustrate, most occurrences of star thistle in montane forests are associated with silvicultural and construction activities. Alternatives that employ extensive mechanical thinning to reduce fire extent and severity or that would increase traffic on unpaved roads might simultaneously increase the rate of establishment and spread of exotic species of concern. The road system requirements for extensive mechanical thinning and possible impacts of those roads on watershed processes, wildlife, are also not apparent in the analysis.

2. Other general observations

a) The absence of explicit, plausible scenarios of future climate, population growth, and changing social values and demands, weakens the analyses of the alternatives.

b) There is a general lack of attention to differences in institutional and jurisdictional impediments and concerns by the different alternatives and management strategies. In particular, the relationship between the USFS and other agencies concerned with wildfire and public health and safety could have been better articulated.

c) The FEIS is confusing in its treatment of fire. On the one hand, it asserts that fire must be returned to the system (i.e., burned acres increased) and that wildfire extent is less of a concern than fire severity. The report then proceeds to use burned area as the basis for comparing alternatives with the explicit assertion that more wildfire is undesirable. Obviously, this assumes that all wildfires are bad and all controlled burns are good.

d) The frequency distribution of fire size and severity is strongly skewed, so "average" area burned has little meaning. The SNEP chapter by Erman and Jones and other recent papers (e.g., Moritz , 1997, Ecological Applications 7:1252) suggest other approaches to fire history analysis and risk assessment that would be more informative.

e) There is little or no attention to the effects of mechanical fuel thinning on soil structure and hillslope processes. The ecological comparability of mechanical thinning and burning remains an open question.

f) Blanket application of a particular prescription, for example, the use of 1.5 mile-wide urban intermix zones, would have disproportionate affects on those kinds of environments where settlement occurs (valley bottoms, lower footslopes, some ridges). If followed literally, giving precedence to fuel reduction throughout these broad intermix zones could have serious consequences in specific habitats and subregions.

g) Foothill riparian systems are the most highly degraded of all the riparian systems in the region. The buffer strategies developed by SNEP were principally focused on conifer systems and it is not clear that a similar logic would apply to blue oak woodlands or other lower montane hardwood systems. Restoring lower elevation riparian ecosystems is not clearly identified as a priority in any alternative or in the discussion of lower Westside forest ecosystems.

h) SNEP identified exotic species as a major threat to native fish, amphibians, and invertebrates. Exotic species control is mentioned under Aquatic Management Strategy goals (Figure 2.2.) and briefly touched on under some alternatives in the Standards and Guidelines (Appendix D). The problem would seem to warrant a more ambitious and proactive approach than indicated by any of the alternatives or described guidelines, both in limiting future introductions and accelerating restoration efforts.

i) Why was the problem of alien terrestrial species narrowly limited to noxious weeds, which thus far have had relatively minor impact at mid-to-high elevations? This diminishes the more general problem of alien species and the relationships different management practices and alternatives and the distribution and abundance of exotic species of plants, pathogens, insects, and vertebrates.

Old Forest Conservation – Reviewer Comments from William McKillop:

"Was the Breadth of Available Scientific Information Used"?

1. Old Forest conservation.

(1) Inadequate attention has been given to presentation, for each alternative, of estimates of current and future mortality, growth and inventory of total biomass and of various size classes of trees. This issue is further addressed in a comment in section 5 below.

(2) It is important, in choosing a wildfire occurrence baseline, to use a credible estimate of annual acres likely to be burned by wildfire in the future. The most credible one suggested to date is the average acres burned during 1986 to 1996 (72,500 acres) plus an allowance for future build-up of biomass. It was implied in chapter 3.5, page 3-183 that the baseline that appears to have been used was the average during 1970 to 1996 (47,110 acres). This is much less credible. However, it is now my understanding, based on an announcement at the Science Consistency meeting on November 13 that the wording in the FEIS will be changed to confirm that the average acres burned during 1986 to 1996 (72,500 acres) plus an allowance for future build-up of biomass was used in the final analysis for all National Forest.

(3) Inadequate attention is given to forest health issues in terms of vulnerability of tree cover to attack by insects and disease. This issue is further addressed in a comment in section 5 below.

(4) Pre-European-settlement forest ecosystems were robust against disturbance by catastrophic wildfire and provided habitats for species of current concern. Their character is an important target (desired future condition) for the various alternatives to aim for. It is therefore important that a determined effort be made to provide a best-available estimate of their likely structure (especially tree diameter distributions and density) and acreage by seral stages. A thorough effort needs to be made to develop and, if possible, to improve upon estimates provided by Professor Thomas Bonnicksen of Texas A & M University in the Report of the California Forest EIS Review Committee to US Senate Subcommittee on Forest and Public Land Management and House Subcommittee on Forests. May 21, 1998 (available through the Sierra Nevada Framework website)

2. Fire and fuels.

(1) It is important, in choosing a wildfire occurrence baseline scenario, to use a credible estimate of annual acres likely to be burned by wildfire in the future. The most credible one suggested to date is the average acres burned during 1986 to 1996 (72,500 acres) plus an allowance for future build-up of biomass. It was implied in chapter 3.5, page 3-183 that the baseline that appears to have been used was the average during 1970

to 1996 (47,110 acres). This is much less credible. However, it is now my understanding, based on an announcement at the Science Consistency meeting on November 13 that the wording in the FEIS will be changed to confirm that the average acres burned during 1986 to 1996 (72,500 acres) plus an allowance for future build-up of biomass was used in the final analysis for all National Forest.

(2) Any alternative that seeks to use significant levels of prescribed fire without first reducing fuel loadings mechanically fails to give adequate recognition to the great difficulties associated with that course of action. These are: air quality restrictions, budgetary constraints, dangers of fire escapement, and very limited periods and opportunities when all of the factors such as fuel loadings, fuel moisture, existence of defensible perimeters, and weather conditions, especially wind velocity, are at levels appropriate to burn).

(3) Too little attention is given to the operational, budgetary and environmental difficulties of using prescribed fire. More emphasis needs to be given to the necessity of reducing fuel loadings by mechanical means as a precursor to significant use of prescribed fire. More attention needs to be given to the potential of generating revenue by removing merchantable material as part of a program to reduce fuel loadings and using that revenue to subsidize the removal of non-merchantable material.

Appendix VIII.

Reviewer Comments
Aquatic Community Conservation
(Aquatic, Riparian and Meadows)

Aquatic Community Conservation – Reviewer Comments from Rick Kattelmann1:

General
1) breadth of available science?
Yes (apparently), but not obviously tracked

2) science interpreted accurately?
Yes, major interpretations seem to be adequate; bias was not identified

3) uncertainty, risk
No, uncertainties should be described more explicitly. It is important to acknowledge the unknowns, limited understanding, and poor quantification of many aspects of the EIS. Risks associated with alternative courses of action should be described in a more thorough manner. For example, the risks associated with severe wildfire should be compared with the risks of extensive fuels treatment.

4) projected consequences
Yes, the described consequences are in general agreement with recent research and "science-based" assessments of environmental conditions

Aquatic
a) range of conditions
Yes, the array of conditions was adequately described via reference to the SNEP evaluations

b) restoration
Yes, the need and means for restoration are adequately identified. However, the financial and administrative resources needed to initiate restoration at a significant scale at not adequately described.

c) goals for watershed management
Yes, the goals for improved watershed management are adequately identified. However, the means to implement such goals are not clear

d) analytical foundations
Yes, the analytical foundations to facilitate aquatic conservation seem adequately developed via the aquatic conservation strategy and riparian conservation objectives. The use of watershed analyses as a basis for management decisions represents major progress. An adequate method for assessing cumulative watershed effects is still needed. We were told that the ERA procedure had been abandoned in favor of some other technique, but I do not think any of the available methods have adequate verification.

Caveats and qualifications

We don't know exactly what information was considered, given the limited citations in the text. Most of my reactions to these eight questions were based on the many citations to the SNEP chapters. There has been relatively few advances in scientific understanding relevant to management of resources in the Sierra

Nevada in the past five years except the work on amphibians and introduced fish conducted by Mark Jennings, Roland Knapp, and their colleagues.

Under the time constraints of this assignment, I was often unsure if material was missing or I was just not seeing something I expected to find. I usually gave the benefit of doubt to the authors. During the discussions with team members, we heard a lot about the ongoing work on the document. In that regard, we were reviewing an incomplete document supplemented with hearsay.

Aquatic Community Conservation – Reviewer Comments from Lynn M. Decker:

I have hesitations regarding this task and about the conditions under which the Science Consistency Check is being completed. I was assured by members of the ID Team and EIS Science Team that these changing conditions were probably much worse when it came to the aquatic, riparian and meadow components and also that these sections had not had as much time spent on them. I would like to have my comments included only with the caveat that they cannot be construed as a science consistency check for the following reasons.

1. Many of the sections I reviewed were apparently incomplete and/or in the process of being changed as we worked on the check November 13th –15th. There is no real way to complete the check without knowing what is really in the document. This is not fair to either the science consistency check process or the EIS.
2. The was no time to do any more than a swift review of a limited number of sections due to the time constraints put on the check. It is unreasonable to assume that a complicated EIS of this magnitude can be reviewed in less than one week.
3. The limited time for preparation ahead of time and interaction during the Davis meeting further handicapped the check especially in the area of integration. Without analyzing the science in the integrated context I think we have done less than half of the work.

Consequently what I can provide to you at this point are notes and science consistency concerns but do note constitute a real science consistency check in my mind.

Topics from the November 6th draft that I reviewed and have made some comments on include:

Aquatic Ecosystems
Riparian Ecosystems
Water Quality
Soils (as it pertains to the delivery of sediment and nutrients)
Aquatic Species
Semi-Aquatic Species
Riparian dependent Species
"Strategy" Components:
1) Aquatic strategy goals
2) Watershed restoration
3) Designation of riparian areas
4) Certain standards and guidelines designed to maintain and protect aquatic, riparian and meadow ecosystems and associated species
5) A long-term strategy for anadromous fish producing watersheds on the Lassen National Forest

Meadows – not provided in the November 6th edition and therefore was not reviewed or commented on.

Viability Analysis for Fishes – I took a look at this because I was led to believe that the Viability group did not. What I find is that they did not appear to do a viability analysis for the fishes but a vulnerability

assessment. This was different than the other species groups and it was not explained why the approaches were different. Right now I am surmising that this is an area that is undergoing change. The reason I am concluding this is because I thought the regulations were very clear that viability had to be addressed and the draft we have seems to avoid using the term.

RF Questions by Issue Area:

4. Aquatics

a. Have we adequately portrayed the range of conditions found in California's watersheds in the Sierra Nevada?

Was the breadth of available scientific information used in the preparation of the EIS and subsequent ROD?

I believe that the presentation of the conditions misrepresented the portrayal of watershed, aquatic and riparian conditions in the SNEP document that was cited. While SNEP did say that there were greater problems as you moved to the valley floor, they did not portray conditions as good on the forests as implied. I believe there is a contradiction also in the CWE/ERA discussions where it shares that the FS own data shows a significant number of watersheds in poor condition. It would be helpful in all these sections to cite references or the agencies own data instead of the general reassuring narrative that predominates the Aquatic, Riparian and Meadow sections as well as the water quality sections.

Was the available scientific information interpreted accurately and without bias?

The sections that I read (except for Soils) did not contain many science references and the references that were cited were mostly review articles. The bias in the writing that persisted was an overly optimistic viewpoint of the condition of watersheds that is not necessarily consistent with SNEP or available data. It did not seem that emphasis was put on collecting available data analyzing it and presenting it in the document.

Were risks and uncertainties surrounding the scientific information acknowledged and adequately displayed?

See above.

Are the projected consequences of management actions consistent with scientific information?

While they are consistent with the current portrayal I think that the consequences would likely be seen to be different if a science-based assessment were done to start with.

4. Aquatics

b. Have we adequately identified the need for restoration and provided the tools to carry out restoration?

Was the breadth of available scientific information used in the preparation of the EIS and subsequent ROD?

While the need for restoration was clearly identified there are concerns that I have with the way restoration is discussed. The science of restoration and the present state of restoration science should clearly be discussed. The document should also clarify if the strategy is really restoration or rehabilitation. The current presentation is not a very thoughtful discussion of the realities of restoration science. The document shares a very optimistic perspective for "restoring" watersheds, streams, lakes, riparian, etc. There are references available that discuss what we do and don't know, what is feasible and what is likely infeasible. For example, it is debatable that we can restore streams, and lakes may be even more impossible to propose that we can restore (e.g. there is little if any evidence that you can reverse the

sedimentation process into certain natural lake types and into meadows, once they fill in they are different habitats). This also differs in our ability to restore structure in riparian ecosystems, and restoring structure is very different for restoring process and function. Since this seems to be the main leg of the ACS I think a critical treatment is necessary.

Was the available scientific information interpreted accurately and without bias?

The current bias is that we can restore almost anything and that is really not supported by the literature or the agencies' experience.

Were risks and uncertainties surrounding the scientific information acknowledged and adequately displayed?

No

Are the projected consequences of management actions consistent with scientific information?

No, and this is primarily due to the unsupported optimism about restoration as well as an unsupported view that restoration can occur without ceasing degradation of structures, processes or functions in the riparian systems for example. Also the analysis of consequences should analyze restoration with some rigor much like the fire and fuels sections so the context, risks and opportunities can be compared.

4. Aquatics

c. Have we adequately identified goals that would guide watershed management?

Was the breadth of available scientific information used in the preparation of the EIS and subsequent ROD?

A conditioned yes here because while the components are present in name, the understanding of them seems fuzzy. Further analysis of the consequences should include analyzing the ability to proceed towards the desired conditions given a more scientific understanding of the functions of and processes important in these systems, the current conditions and trends and how the management proposed presents risks and opportunities. One of the points shared was that the team really did not develop an ACS for the Sierra but more borrowed things that were already being implemented elsewhere through EIS's. This approach is very different than assessing the risks and needs for the Sierra and coming up with a scientifically based ACS.

Was the available scientific information interpreted accurately and without bias?

The goals that provide the basis are not all scientifically based but many are the restating of laws, etc. Which does not necessarily mean that they were not based on science but they are the result of a planning process, compromises, etc., themselves. If that is what they are going to be it should be stated. If you want to have the goals interpreted as being based on science then it will be necessary to trace back and cite the science.

Were risks and uncertainties surrounding the scientific information acknowledged and adequately displayed?

No, restoration discussions are a good example as noted above.

Are the projected consequences of management actions consistent with scientific information?

Since not much "science" was cited it is difficult to say but the document does consistently display the most optimistic outcome conceivable from what is presented. The writing tends to be more reassuring narrative than analysis.

4. Aquatics

d. Have we adequately developed the analytic foundations to facilitate aquatic, riparian and meadow conservation?

Was the breadth of available scientific information used in the preparation of the EIS and subsequent ROD?

There are substantial misinterpretations or misrepresentations of both approaches for riparian delineation and no real connection to the original science basis behind either approach. Also, it appears that there is a misunderstanding of riparian "buffers" and the science behind them. When these concepts are all mixed together as they are in the document the analytic foundation becomes so muddled that the conservation goal is compromised. I'd suggest tying back to original literature on these subjects.

There is an apparent lack of understanding of the function of small streams (especially ephemeral and intermittent). There is not science that I know that supports the differential treatment of these systems as developed in the EIS and the EIS does not provide anything to support either different delineations or different needs for protection. There is also no science presented here, and I am not certain that it exists, that the treatments described will lead to the expected outcomes or states. The team needs to look back at the ecological roles and functions of these systems and thoughtfully analyze what is needed for conservation or what disturbances are to be accepted because the conservation of these systems is in conflict with the approach proposed for dealing with the fire and fuels issues.

Also, lakes and streams cannot be addressed similarly. They are very different systems and should have separate discussions. For example the analysis of sediment and nutrient inputs should be very different for lakes. The consequences section should discuss the consequences of the alternatives in regards to eutrophication. Given a more thoughtful analysis conservation measures will probably include some different ideas than currently presented.

There is very little discussion on processes and functions in these systems. At a minimum a discussion of nutrient and sediment processing and delivery are necessary given the purpose and need and a discussion of chronic as opposed to pulse disturbance.

All of the numbers used in the S & G's and goals should be explained. Not all have a "scientific" basis but should be explained for what they are. For example, there is no science basis for allowing 10% bank damage due to grazing. This is a management decision/compromise and should be stated as such. Other numbers that need to be footnoted include: stubble heights, TOC's, ERA's and the current riparian widths if the are kept the way they are proposed in the November 6th draft.

Was the available scientific information interpreted accurately and without bias?

It appears not to have been used very extensively.

Were risks and uncertainties surrounding the scientific information acknowledged and adequately displayed?

No

Are the projected consequences of management actions consistent with scientific information?

Probably more optimistic than a review of the literature or the agencies own data would support.

5. Integration

a. Have we adequately identified the uncertainties and risks of managing in riparian areas for fire and fuels, habitat conservation, and human access and use?

Was the breadth of available scientific information used in the preparation of the EIS and subsequent ROD?

A clear discussion of the conflict of meeting desired conditions for fire and fuels and aquatic, riparian and meadow systems should be discussed. We were informed verbally that the spatial overlap was 14%. I think that this merits discussion and probably some direction on how conflicts are resolved. This will affect the consequences section of the document. The potential for the fire and fuels needs to produce more or less chronic inputs of sediments and nutrients than may have been the more "natural" conditions also needs to be discussed.

There needs to be a clarification and a sharing of the science behind the assumptions for the role of fire in the present systems as well as referencing what it is thought was the historic role.

Was the available scientific information interpreted accurately and without bias?

As the science is more clearly discussed in the revision any bias can be evaluated by the next science consistency check. However in the draft I reviewed there appeared a clear bias that if the "treatments" weren't done the riparian would surely burn up, and this would be a catastrophe. Seek through the literature to validate, discredit or be more spatially explicit with the assumptions. What will burn, where, and if it does what it is a "catastrophe for". Finally evaluate the effects of the treatments versus the effects alternate or no treatments, not just on the fire strategy but the ACS as well.

Were risks and uncertainties surrounding the scientific information acknowledged and adequately displayed?

Not well.

Are the projected consequences of management actions consistent with scientific information?

See above

Aquatic Conservation – Reviewer Comments from Mark Jennings:

1). Was the breadth of available scientific information used in the preparation of the FEIS and subsequent Record of Decision (ROD)?

Overall, I find that the amphibian sections are better written and include more information than the reptile sections. The write up on western pond turtle especially needs to include information from recently published work on genetics (Gray 1995; Conservation Biology, 9(5):1244-1255) and ecology (Reese and Welsh 1997; Proceedings: conservation, restoration, and management of tortoises and turtles—an international conference, 352-357. Goodman 1997; MS Thesis, California State Polytechnic University. Goodman 1997; Chelonian Conservation and Biology, 2(3):419-420. Davis 1998; MS Thesis, San Jose State University. Reese and Welsh 1998; Journal of Wildlife Management, 62(3):842-853. Reese and Welsh 1998; Journal of Herpetology, 32(4):505-515). I would also suggest that more information needs to be

included in the write-ups that are not currently published (e.g., more "unpubl. data" or "pers. comm."). For example, Vance Vredenberg has important information on mountain yellow-legged frogs and Sue Christopher has important information on California red-legged frogs based on their dissertation work. I can provide a complete list of contacts if the authors would like.

2). Was the available scientific information interpreted accurately and without bias?

For the most part "yes". However, I note a tendency to cite summary material (e.g., Jennings and Hayes 1994) when one should actually cite the original papers cited in Jennings and Hayes (1994). Thus, the authors need to carefully go through the draft and add more of the primary literature to their statements and conclusions. This is especially important for information that has changed since the Jennings and Hayes (1994) and Jennings (1996) reports have been published. Also, there are a number of typos and duplications in the text. I noted that Jennings and Hayes 1994 is duplicated in the Literature Cited section.

One problem I encountered is determining where the values for the panel assessment ratings came from. I cannot judge whether this information is accurate or not. Perhaps a brief discussion of how these values were generated and their limitations should be included in both the amphibian and reptile sections.

The authors need to also do some panel assessment ratings for crayfish (*Procambarus clarkii* and *Pascifasticus* spp.) and bullfrogs (*Rana catesbeiana*). If these two exotics have high ratings for the preferred alternatives, this could cancel out the benefits of management actions for native species you are trying to protect. This is very important because these two exotics often turn up in locations by accident that the Forest Service has no control over. For example, it could even be as simple as something like sucking up bullfrog larvae in a water bucket and transporting them by helicopter to a fire site where they are dropped into a local creek far removed from a known bullfrog source. The Forest Service would then not want to do management decisions that would benefit such accidental introductions.

3). Were the risks and uncertainties surrounding the scientific information acknowledged and adequately displayed?

Yes for amphibians and partly so for reptiles. The three reptile species need to be beefed up more. I would also suggest stating "no data are available" where there are no data. Additionally, the threat of fire to aestivating western pond turtles needs to be addressed. I would suggest talking to Sam Sweet (at UCSB) about this subject.

4). Are the Projected Consequences of Management Actions Consistent with scientific information?

The projected consequences of management actions were consistent with the scientific information presented. However, I do question if some of these management

actions are actually going to be implemented. The reality of the situation is often very different from what was planned. This document must stand on its own with regards to what ever is said will be implemented. You cannot make suggestions that will not be conducted by each of the Sierra Forests on the ground.

Additionally, the amphibian and reptile sections need to be better incorporated with the other sections. There should be references to the mammal and bird sections, as well as the fish sections and vice versa. Also, I note uneven coverage with many of the chapters. For instance, the mammal sections have literature citations after each species, while the amphibian and reptile sections do not. All of the literature citations need to be removed from the text and incorporated at the end. Also, they all need to be checked for accuracy.

Aquatic Conservation – Reviewer Comments from Carolyn Hunsaker:

I was assigned to the Aquatic, Riparian, and Meadow (ARM) ecosystems portions of the draft FEIS so I have answered the four questions primarily for those sections. I also have some general comments listed.

For the ARM portion of the draft FEIS, it was quite confusing as to what we were really reviewing since staff verbally informed us that much of the material provided was not exactly what was going to be in the FEIS. No up-to-date material was provided for meadows so I have no comments on meadows.

1. Was the breadth of available scientific information used in the preparation of the FEIS and subsequent Record of Decision?

Qualified yes. I have some qualifications such as the need for a more a balanced presentation about fire for aquatic ecosystems--see discussion below.

The ROD was not provided for review so I cannot comment on this part of the question.

2. Was the available scientific information interpreted accurately and without bias?

Yes

3. Were the risks and uncertainties surrounding the scientific information acknowledged and adequately displayed?

Qualified yes; however, this treatment was somewhat uneven. For example, fire can be viewed as both a positive and negative effect. It is more likely that fire in the Sierra Nevada should be presented as a positive effect, even for wildlife, but the restricted operating periods and concern about fire in riparian areas makes one wonder. It would have been nice to see more quantification for this topic.

The importance of the monitoring plan, Appendix E, needs to be stated throughout the text in a more effective manner.

4. Are the projected consequences of management actions consistent with scientific information?

This is difficult to say but I would answer yes, as best as we know.

One of my primary concerns was that the original standards and guidelines (S&Gs) did not logically flow from the material provided in Sections 2 and 3. However, the material provided in the new section "riparian conservation objectives and accompanying standards and guidelines for

management activities within riparian conservation areas and critical aquatic refuges (7 page document)," is nicely linked to "riparian conservation objectives" which interface with the aquatic conservation strategy. These S&Gs provide an adequate level of flexibility (i.e., some short-term effects are allowed provided they are expected to result in long-term benefits).

When specific (numeric) standards are provided their source should be stated (data/research citation, best expert judgment/personal communication, or previous standard practice/BMP). As an example, take the Riparian Conservation Areas for Alternative 6. The text needs to state the justification/source for the width of the RCAs given in the table by stream type. (Note: the reviewers were in general agreement that the source of S&Gs or operating periods should be explicitly stated for all sections.)

Better cross-referencing needs to be provided between sections. For example, there should be cross-referencing between the fire and fuels section and the ARM section; this is relevant to question 1 listed above.

The text needs a better treatment of fire (both wildfire and prescribed) in riparian areas (empirical data and literature). If there is very little data, say so. Basically we have more information on wildfire (hot burns) than we do on prescribed fires (cool burns). From fire history data we know that riparian areas burned but perhaps less frequently; such information is not discussed with respect to restrictions on fire in riparian areas. This is an area of uncertainty. There should be references between sections in cases like this that link what is known, the degree of uncertainty, how this fits into the adaptive management approach, and then the relationships to the monitoring and in this case need for cause and effect research (under fire).

It should be clear for what reasons restrictions in riparian areas are being set--terrestrial organisms, aquatic, or both (and what supports the need for the restrictions). Sierra Nevada references I know of include the following although these only address water chemistry.

-Williams, M.R., and J.M. Melack, 1997, Effects of prescribed burning and drought on the solute chemistry of mixed-conifer forest streams of the Sierra Nevada, California, Biogeochemistry 39:225-253

-Chorover, J., P.M. Vitousek, D.A. Everson, A.M. Esperanza, and D. Turner. 1994. Solution chemistry profiles of mixed-conifer forests before and after fire, Biogeochemistry 26:115-144.

Also, in riparian areas, what are the tradeoffs between mechanical treatment and prescribed burns and what science supports this information? This is an area of uncertainty.

The text is somewhat confusing by mixing concepts about stream buffers whose purpose is to protect streams from terrestrial inputs such as sediment and polluted runoff with the concept of stream protection to insure inputs such as insects and litter. The most recent text is somewhat better but this could be improved.

There are also some good general references in the literature about buffers along streams--none of this work is cited in the document. For example—

Weller, D.E., T.E. Jordan, and D.L. Correll. 1998. Heuristic models for material discharge from landscapes with riparian buffers. Ecological Applications 8(4):1156-1169.
"For unretentive buffers, average width is the best predictor of landscape discharge, while the frequency of gaps was best for narrow, retentive buffers. Together, both predictors explain >90% of the variance in average landscape transmission for any value of buffer retentiveness."

Appendix IX.

Integration and Adaptive Management.

Reviewer Comments – Martin Raphael:

Other comments - Monitoring and adaptive management

Appendix E (of the draft FEIS) contains a remarkably thorough monitoring plan for terrestrial species. Monitoring is essential to the adaptive management process, and adaptive management is proposed as the process for dealing with uncertainty in the viability assessments. However, the proposed monitoring program is overly ambitious in that I doubt that the agency would be willing to fund the work to complete the proposed components at a level of effort necessary to yield reliable results. Assuming I am correct that funding will not permit implementation of the full proposal, choices will need to be made. I recommend the addition of some ranking criteria to identify the most important components – to prioritize the long list of monitoring questions and components. Recognition of the likelihood of reductions in this menu of monitoring activities will help skeptics believe that a serious attempt will be undertaken to implement a realistic set of monitoring actions. In addition, the agency should not promise more than it can deliver. As we saw from the court rulings from the Northwest Forest Plan, a judge will hold the agency accountable for the monitoring work specified in the plan. Failure to carry out that monitoring may very well lead to a court-imposed injunction against any activity in the plan. Adaptive management requires a commitment to use the information derived from the monitoring plan. Hopefully, the final documents will specify institutional mechanisms to incorporate monitoring information and respond accordingly.

Reviewer Comments – Frank Davis:

a) The absence of explicit, plausible scenarios of future climate, population growth, and changing social values and demands, weakens the analyses of the alternatives.

b) There is a general lack of attention to differences in institutional and jurisdictional impediments and concerns by the different alternatives and management strategies. In particular, the relationship between the USFS and other agencies concerned with wildfire and public health and safety could have been better articulated.

c) The FEIS is confusing in its treatment of fire. On the one hand, it asserts that fire must be returned to the system (i.e., burned acres increased) and that wildfire extent is less of a concern than fire severity. The report then proceeds to use burned area as the basis for comparing alternatives with the explicit assertion that more wildfire is undesirable. Obviously, this assumes that all wildfires are bad and all controlled burns are good.

d) The frequency distribution of fire size and severity is strongly skewed, so "average" area burned has little meaning. The SNEP chapter by Erman and Jones and other recent papers (e.g., Moritz , 1997, Ecological Applications 7:1252) suggest other approaches to fire history analysis and risk assessment that would be more informative.

e) There is little or no attention to the effects of mechanical fuel thinning on soil structure and hillslope processes. The ecological comparability of mechanical thinning and burning remains an open question.

f) Blanket application of a particular prescription, for example, the use of 1.5 mile-wide urban intermix zones, would have disproportionate affects on those kinds of environments where settlement occurs (valley bottoms, lower footslopes, some ridges). If followed literally, giving precedence to fuel reduction throughout these broad intermix zones could have serious consequences in specific habitats and subregions.

g) Foothill riparian systems are the most highly degraded of all the riparian systems in the region. The buffer strategies developed by SNEP were principally focused on conifer systems and it is not clear that a similar logic would apply to blue oak woodlands or other lower montane hardwood systems. Restoring lower elevation riparian ecosystems is not clearly identified as a priority in any alternative or in the discussion of lower Westside forest ecosystems.

h) SNEP identified exotic species as a major threat to native fish, amphibians, and invertebrates. Exotic species control is mentioned under Aquatic Management Strategy goals (Figure 2.2.) and briefly touched on under some alternatives in the Standards and Guidelines (Appendix D). The problem would seem to warrant a more ambitious and proactive approach than indicated by any of the alternatives or described guidelines, both in limiting future introductions and accelerating restoration efforts.

i) Why was the problem of alien terrestrial species narrowly limited to noxious weeds, which thus far have had relatively minor impact at mid-to-high elevations? This diminishes the more general problem of alien species and the relationships different management practices and alternatives and the distribution and abundance of exotic species of plants, pathogens, insects, and vertebrates.

Reviewer Comments – William McKillop:

(1) Chapter 2 section 4, Comparison of Alternatives, is not available at this time. When it is written it important that it provide a proper perspective on issues of crucial importance in assessing socio-economic aspects of the FEIS. At the moment, there is inadequate analysis and evaluation of the economic and social consequences of the various alternatives. A number of aspects need substantially greater consideration and treatment.

(2) One aspect is the budgetary feasibility of the various alternatives. It is noted in chapter 3.5, page 3-177 that the SPECTRUM modeling was not constrained to reflect

budgetary limitations for prescribed burning. The analysts who ran SPECTRUM are to be highly congratulated on the impressive job they did with such a huge, complex problem. Time limitations and the magnitude of the modeling effort may have made it infeasible to consider budgetary constraints within the model or by sensitivity analyses. If that is so, such constraints should, nevertheless, have been recognized in the development of alternatives either in the form of realistic point estimates, or realistic ranges, of funding levels. The essence of good decision science is providing policy makers with complete information. Recognition of budgetary constraints should be an integral part of this FEIS.

(3) SPECTRUM runs, similarly, did not incorporate constraints on smoke emissions or limitations on operating periods for scheduling treatments. Chapter 3.5, page 3-177 notes that "Any of these constraints may reduce or reduce the actual number of acres treated within each of the alternatives. Thus, remarks in (2) above apply equally here.

(4) Another aspect is employment and income. It does not appear that the FEIS will show direct, indirect and induced effects of the various alternatives on total regional income and employment. For example, FEIS shows only direct employment effects in spite of the fact that the incomplete table 6.2b in Chapter 3 implies that Type II employment multipliers will be presented. It is a small, but highly desirable, step to apply multipliers to direct job impacts to estimate total impacts on both income and employment.

(5) An additional aspect is the failure to provide information on net revenues for each alternative. This information is readily obtainable. It is important because it gives an indication of the burden on taxpayers implied by the various alternatives and the impact on national income of the various alternatives.

(6) An essential element of good socio-economic analysis is examination of trade-offs between various benefits provided by different policy alternatives. In cases where some benefits are monetary and some are non-monetary, a classical benefit-cost analysis is not adequate. However, a cost-effectiveness analysis can be carried out by examining the absolute or incremental costs of providing different levels of non-market benefits. In the case of this FEIS costs can be estimated, for each alternative, by such measures as regional income and employment foregone or reductions in net revenue (representing the cost to federal taxpayers). Non-market benefits in this case are such things as number of pairs of species of concern provided for, numbers of large trees preserved, acres set aside in "no-touch" old forest or riparian zones etc.

(7) The preferable method of examining trade-offs and incremental costs and benefits is to use the sensitivity analysis capabilities of linear programming models such as SPECTRUM. If that approach is not followed, an analysis can be conducted using SPECTRUM outputs. Incremental losses in net revenues can be estimated by the difference between the net revenue of any particular alternative and the highest net revenue in the set of alternatives. Incremental benefits can be estimated by the increase in the level of a non-market benefit relative to that for the highest net revenue alternative.

More needs to be done to examine trade-offs in this FEIS because they provide decision-makers with a powerful way of gaining perspective and clarifying issues.

(8) Certain aspects of the sections on recreation need correcting and improvement. Although recreation and tourism make significant contributions to local economies in the Sierra Nevada, it should be emphasized that those contributions will continue regardless of which alternative or combinations of alternatives is chosen. One exception might be the case of an alternative that involves a significant levels of road closures, because the vast bulk of National Forest recreation is road-based.

(9) One specific part relating to recreation that needs correction is the first sentence in section 5.6I. It incorrectly states that recreation on the national forests "contributes significantly to the nation's economy". This is a repeat of an error made in the U.S. Forest Service Draft 1995 RPA Program document (which was withdrawn because of its defects). National forest recreation is neither a significant exporting or import-substituting sector and therefore makes no significant economic contribution at the national level. The reason is that, if people do not spend money on national forest recreation, they will spend it on other types of recreation or in other ways.

(10) In contrast to recreation, National Forest timber contributes significantly to the nation's economy because it restrains the level of imports of lumber from Canada and elsewhere. This point should be included in the section (5.1) dealing with commercial forest products.

(11) Inadequate attention is given to forest health issues in terms of vulnerability of tree cover to attack by insects and disease. There appears to be no comprehensive discussion of tree disease and insect issues, only limited references, mainly in connection with alternatives 4 and 6 in Chapter 2, and old forest and hardwood ecosystems in Chapter 3. There appears to be inadequate recognition that the issue has relevance in terms of recreation, scenic quality and fire hazard as well as timber growth and viability.

Reviewer Comments – Rick Kattelmann:

Miscellaneous issues

As a science-based plan for improved resource management in the Sierra Nevada, the Forest Plan Amendment is a huge step forward. In that context, most of my differences of opinion with parts of the document seem trivial. Nevertheless, there are a few issues that I hope will be addressed as the final version is prepared.

The different sections that consider the interactions between resources and management must be made internally consistent. Editors assigned to various high-profile issues could search out those linkages and clean up the divergent text relatively easily. Cross-referencing between sections would also help.

Trade-offs between different management strategies need to be described and emphasized in the executive summary. Conflict between fuels treatments and aquatic conservation is a primary example.

Candid assessments of the potential for successful implementation of major changes in management direction are essential. Although many of the goals are commendable, they may not be practical. Does the USFS have the qualified personnel and funding to prepare thorough watershed analyses? Does the USFS have the qualified personnel and funding to implement fuels treatments across vast areas of the range? Will the USFS obtain sufficient funding to adequately maintain the current road system, let alone make significant progress in rehabilitating roads that are the primary sources of accelerated sediment delivery to streams?

The potential adverse effects of extensive fuels treatments to streams need to be described in greater detail.

The fundamental assumptions, biases, and potential errors of the modeling exercises should be clearly described.

The scientific rationale for each of the standards and guidelines should be documented somewhere to allow modification of the standard or guideline in the light of new scientific information. Availability of such reference material would place the S&Gs in a science or conventional-wisdom context and allow for changes under adaptive management.

Greater visibility should be given to scientific uncertainties. Although there are obvious political and public-relations difficulties in stating "we don't really know" too often, that is the honest course of action and should help in pursuing a greater understanding of the environment of the Sierra Nevada.

Reviewer Comments – Lynn M. Decker:

Integration:

e. Have we adequately developed an approach to adaptive management that deliberately develops information to revisit our assumptions, develops new information, and lift the veil of uncertainty?

Was the breadth of available scientific information used in the preparation of the EIS and subsequent ROD?

The problem may be that the whole breadth was used. It is so broad that keeping the connections to the plan and plan implementation will be important. It would be helpful to portray the expected time period for answering questions. Some will take a very long

time to reach conclusions about and the risk is that we find out something is not working only after 15 years of implementation.

Was the available scientific information interpreted accurately and without bias?

Yes

Were risks and uncertainties surrounding the scientific information acknowledged and adequately displayed?

Yes

Reviewer Comments – Carolyn Hunsaker:

General comments

Our science knowledge base is not such that we could write a set of standards and guidelines for a bioprovince like the Sierra Nevada, with all its heterogeneity, without having some conflicts at a smaller geographic scale. The provision for landscape/watershed analysis for smaller geographic areas is a very critical process to resolving conflicts between S&Gs, dealing with unique ecological situations, changes in knowledge base such as new models and data, etc. Regional planning, geography, and landscape ecology all tell us we need ecological analyses at several scales to even attempt ecosystem or adaptive management. My approval of the science quality of this document is contingent on that fact that landscape/watershed analysis has a role in defining what can be done on a certain piece of land, i.e., can "refine" S&Gs where needed. Such flexibility is necessary if this is to be a science-based plan. There will be seeming conflicts between management approaches such as prescribed fire and concerns about sensitive wildlife species. Landscape analysis can help sort out these seeming conflicts.

Time is also a part of scale and is not very well addressed in this document. For example, one might take a short-term risk (prescribed fire and possible effect on wildlife) for the long-term benefit across the population over time (getting forest back into natural fire cycle). Table 3.5r is a good example of this. Why put in restrictive operating periods that appear to exclude any prescribed burning in spring and make a feasible fire plan unlikely when there are no data to support wildlife concerns (i.e., owl and fisher). Again, there is need for an integrated discussion of risk and uncertainty across focus areas.

The old forest, ARM, and species viability sections appear to consider fire as a negative effect. The exclusion of fire is really the unnatural process for the Sierra Nevada (this is based on data) and its exclusion makes wildlife at higher risk due to loss of habitat. The text does not present this view very effectively. Also, it is not effectively addressed in these sections that the reintroduction of fire can be done gradually (multiple entries over time) to lower the risk of negative effects in the short term.

Adaptive management plays a major role in this document and the process it sets up. There needs to be a better connection between the text in Chapters 2, 3, and the questions and monitoring components in Appendix E. This can easily be done by putting citations in the text that point the reader to these other parts. For example, we need to know more about the effects of

prescribed fire on riparian and stream ecosystems; this is called out as a cause and effect research need in Appendix E. The text discussion in both fire and aquatics should state this and point to the stated need in Appendix E.

The monitoring piece, Appendix E, was not given much attention although it is essential for adaptive management. This oversight should be corrected. The different levels of monitoring are also a way to address uncertainty; the higher the uncertainty the more the need for cause and effect research.

There should be a statement in Section 2 that talks about the need for adaptive management experiments that will require experimental treatments that are outside of the S&Gs. Existing areas are exempted but they will not be sufficient for all the needed cause and effect research. A general statement should be added that states the need for some additional areas in the Sierra Nevada that would be exempted from the S&Gs to provide for cause and effect research.