WHITE PAPER

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Silviculture Certification: Tips, Tools, And Trip-Ups[1]

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During the past few years, I had the opportunity to be directly involved with eight certification panels – six Regional panels and two Forest panels. The objective of this white paper is to describe some common themes from these recent panel experiences.

1. **Find help if you are not a good writer**. You are not being certified as a writer or editor, but please make the effort to find help if you are not a good writer. A certification panel bases its certification decision on two primary products – your written document (which is supposed to serve as the main factor), and your oral presentation and prescription defense. If the written document is not professional in appearance, or not clear in content or organization, then it will make your certification process more difficult than it needs to be.

   Tip: if you desire writing assistance, find a trusted employee to help you. Often, an environmental coordinator can fill this role because they tend to do a lot of writing and editing. But regardless of who you ask or what their position is, **be sure they are a good writer or editor** first and foremost.
2. **Cross-check throughout the editing process.** The prescription document tends to go through much editing and numerous versions. If not managed carefully, this situation can lead to contradictory information in different parts of the document.

   Tip: your final document check should look for logic discrepancies, including number inconsistencies. If your economic analysis uses 10 MBF/acre as the harvest volume, but your FVS printout shows 12 MBF/acre being harvested, then be assured

[1] White papers are internal reports; they receive only limited review. Viewpoints expressed in this paper are those of the author – they may not represent positions of the USDA Forest Service.

that someone on the panel will ask about this apparent discrepancy. And, this will occur even if the economic analysis and the FVS results are provided as appendixes. In other words, don't assume that appendix material tucked away at the back of your document is not scrutinized to the same extent as the primary text. [And those darn number issues have a way of cropping up everywhere. If you show 10 MBF in a table, but the document text refers to 12 MBF, this apparent inconsistency will also be discovered and questioned.]

3. **Use cited literature to support your statements**. While I don't recommend you go overboard (and I know it's open to judgment about what constitutes 'overboard'), please be liberal with your use of cited literature to support your statements. And always be cognizant of literature quality – citing a personal communication with the district wildlife biologist is both understandable and expected, but if the bulk of your citations end up in this 'personal communication' realm, then the panel will have concerns about your use of the scientific literature (and rightfully so).

   Why be concerned about citing literature? Your certification prescription document your thought processes, and it demonstrates you have the knowledge and skills to function as a journey-level silviculturist. A natural resource professional must be conversant with foundational science of their discipline. If your prescription document contains few science citations, you are conveying, whether you intend to or not, that most of your discussion is based on personal opinions and judgments, rather than being linked to a firm science foundation. But when you make a statement, and follow it with a literature citation in parentheses, you assert that your declaration not only fits the stand and its circumstances, but is supported by forestry science as well.

   I know there is a body of best available science (BAS) pertaining to your prescription project, and it includes science of high quality – preferably items published in peer-reviewed journals or comparable research station reports (such as research papers), including appropriate science of geographical relevance. Please don't cite longleaf pine research from the southeastern U.S. in support of your ponderosa pine project in eastern Oregon unless you have a good reason for doing so, and you can clearly explain the rationale.

   Tip: Within the page limitations established for your prescription document, please try to include a reasonably deep literature cited section, and be sure it includes the 'correct' references (i.e., strong, high-quality, peer-reviewed, geographically-relevant science). If you are unsure about what the correct references should be, consult other experts – the entomologist assigned to your Forest Health Protection area can provide helpful ideas about BAS for insect susceptibility, for example, and he or she can help ensure it has local relevance. Other local reports such as wa-

tershed analyses or perhaps environmental analysis specialist reports may also be helpful for identifying BAS for your area. Be discriminating when using these other sources, however, because not all of them have done a good job at identifying locally relevant BAS.

4. **Be prepared to support everything included in your prescription document**. If you include a stand exam printout, can you explain the sample design that was used? How about the exam's statistics – did the standard error or standard deviation suggest that enough plots were taken to adequately characterize basal area per acre for the stand? [Don't worry much about trees per acre – it's almost impossible to take enough plots to get good stats for TPA.] Which type of examination level was used (quick plots, extensive, etc.) and why?

   The point here is this: if you include a stand exam report as an appendix in your document, then the panel will assume it had an important influence on your prescription, especially for characterizing site quality (site index), species composition, forest structural stage, and stocking levels, and for conducting FVS modeling. If a stand exam report is included, you need to be prepared to answer questions about the report itself, and the sampling methodology used to generate information presented in the report.

   Trip-Up: Sometimes, a candidate selects a certification stand from within a large project area currently moving through the NEPA process. This means an exam might have been completed before they selected the stand for certification, in which case they were probably not involved with developing the sample design or collecting field measurements. But even so, a candidate still needs to be prepared to handle detailed questions about an exam if it is used for the certification process – responding to questions by stating "I didn't do the exam" is not an acceptable response.

   [Generally, most candidates either complete the stand exam themselves, or are totally involved in its completion – not so they can explain how it was done to a panel, but because it is a good way to become familiar with stand conditions because a comprehensive exam covers the full spatial extent of a stand.]

   Tip: not everyone includes a stand-exam report in their document; if you're not completely comfortable responding to questions about the exam, then consider including a summary table containing key items from it (density as basal area and trees per acre, volumes, site index, species composition, etc.). This can help limit exposure to information you're not prepared to fully defend.

5. **Discretion can be the better part of valor**. Occasionally, but not often, someone on your panel will be incorrect in terms of a factual matter, or they are making what is obviously a wrong interpretation about a matter of policy or direction. No one is perfect, and one of your panelists may be incorrect for a particular item. If someone

else on the panel does not correct them, then you might be faced with the situation of needing to respectfully disagree with them in your response to a question or statement. This can be a good learning experience, and it involves a common situation in life. The trick is to respond respectfully and not get flustered, and to structure your response in such a way that it is not perceived as being critical or judgmental of the questioner.

Tip: First and foremost, be sure you're correct if you choose to phrase your response in such a way that it is clear you believe the panelist to be incorrect. If it turns out they are right, and you are actually wrong, or if the consensus of the panel is that the panelist's interpretation is correct for a policy matter without a clear right or wrong answer, then it could certainly work against you, particularly for a middle-of-the-road situation where there is not a clear 'certify or don't-certify' outcome.

Tip: Consider a response where you dodge the issue entirely. Ignore what you believe is an incorrect fact or assumption, and answer the rest of the question as if the incorrect material wasn't included in the first place. Sometimes, this approach doesn't work well because the incorrect material is part-and-parcel of the question, in which case the question can't really be answered without addressing the incorrect material.

Trip-Up: Catching a panelist giving incorrect information and then arguing with them, or trying to make it into a big deal where either you or the panelist becomes defensive or feels attacked or threatened, is almost never productive, regardless of who is 'right' or 'wrong.' Gently pointing out the inconsistency or incorrectness in your response, and not belaboring it by quickly moving onto the rest of your response, is always the best course of action.

Yes, a panel is designed to be rigorous, and yes you have every right to expect your panelists to be top notch and well prepared, but life is not perfect and discretion may be the better part of valor (i.e., you need to recognize and understand the situation you are in (discretion), and then use these insights to avoid doing something you'll regret in the future).

6. **Carefully complete growth-and-yield modeling for your prescription**. I can't remember the last time this step was accomplished by using any model other than the Forest Vegetation Simulator (FVS). Sometimes, modeling is completed by accepting FVS default values for many parameters, including important items such as maximum stand density index (SDI). And occasionally, accepting the default values causes nonsensical results – a stand adds volume and basal area seemingly forever, eventually reaching 400 ft^2 of basal area and 65,000 board feet per acre, neither of which has <u>ever</u> been observed on the candidate's home unit. As you might expect, a result like this is likely to generate a 'rich and full' discussion during the panel process.

[A nonsensical result often happens when a simulation is attempting to emphasize an early-seral, shade-intolerant species (ponderosa pine) on a warm dry plant association, but the default maximum SDI values are based on a late-seral, shade-tolerant species (generally the climax tree species, such as grand fir). What happens is this: the default maximum SDI values (for grand fir) are so far above appropriate values (for ponderosa pine) that FVS never invokes density-dependent tree mortality (self-thinning), so the stand seems to add basal area and volume forever.]

Trip-Up: Same basic message as for the stand exam printout (item #4) – if you can't support the modeling results, then consider how much of the FVS output to include in your document. But also be aware that growth and yield prediction is central to the prescription process, so expect questions about modeling regardless of how much FVS output is provided to the panel.

At the very least, expect to explain why and how you used the SDIMAX keyword to modify the default maximum SDI values in order to ensure that density-dependent tree mortality (self-thinning) is modeled correctly.

Trip-Up: Not adjusting the maximum SDI values in FVS is the best way to produce a stand with 400 ft^2/acre and 65,000 board feet per acre for sites where this outcome would never be expected. This is not a good thing.

Tip: If you begin to suspect that the FVS 'black box' is providing you with screwy results, and if you haven't worked on your unit for very long, then this is an excellent opportunity to consult with some old timers and ask them to help evaluate your results (such as basal area and volume per acre) to ensure they reflect local conditions.

Trip-Up: Using models other than FVS to support your prescription, such as the DecAID system to analyze various snag and down wood objectives, can be an excellent strategy, but it can present the same issues described above for stand exam (item #4) and FVS results.

[Note: in practice, you'd probably use FVS and its Fire and Fuels Extension to simulate snag production through time, and then compare simulated snag levels against the snag levels recommended by DecAID].

Tip: If you're uncomfortable supporting DecAID outputs and how they were generated, then consider asking a wildlife biologist to complete a snag analysis for your certification stand. If you do this, ask them to include the results, and their interpretations, in a short specialist report, which you can then cite.

7. **Consider how to evaluate alternatives**. A continuing panel issue involves evaluation of alternatives, and the processes used to weight or prioritize them. Generally what happens is this: detailed objectives are hopefully available for your certification stand, they are used as a basis for developing evaluation criteria, and the evaluation criteria are then scored in such a way as to help identify a preferred alternative.

[Note: just like in NEPA, the silviculturist does not select a preferred alternative; you recommend a preferred alternative to the decision maker, who will hopefully follow your recommendation and then select it.]

Often, what happens is this: a long laundry list of evaluation criteria is developed (sometimes reaching 10 or 12 items, which I personally believe is too many items but I suppose it could convey a sense of thoroughness), and then each criterion is scored for each alternative. Why might 10 or 12 items be too many? As you complete your prescription analysis, you will be trying to balance two competing tensions – include enough goals, objectives, and evaluation criteria (and these three items are all related – see appendixes 1 and 2) to demonstrate that a wide range of resources were considered during prescription development, and yet not include so many objectives and evaluation criteria that it becomes difficult for the reader to understand what truly influenced your prescription development (and readers will assume your prescription was developed to address the most important stuff).

The criteria scores may be quantitative (numerical) or qualitative (yes/no, or high/moderate/low). One issue with this approach is that a long list of criteria frequently results in two or more of the alternatives having total scores very close to each other – one alternative may rank well for some criteria and poorly for others, and vice versa for another alternative, in which case they balance each other out and generate similar total scores. This result can make for a challenging discussion about how the preferred alternative was identified because there may not be much separation between the total scores, particularly if the evaluation criteria are not prioritized in some way.

Tip: Use your line officer (Ranger, etc.) to help you prioritize the evaluation criteria. If you have 10 criteria, and if they are rated numerically, then you might end up with scores of 28, 29, and 28 for three alternatives. If this happens, it will be very difficult to use a 1-point difference in the scores as the main rationale for recommending the alternative with a score of 29! But if the criteria are prioritized, and if 4 of them are more important than the other 6, then it is much less likely that all three alternatives will still end up in a tight group like they did for the total scores, particularly if the more important criteria have a higher weighting factor than the less important criteria.

Tip: If you believe you have too many evaluation criteria, and this may be obscuring what's really important for your analysis, then scan the criteria scores to see if some are not varying across alternatives. If you're using numerical scores (3 for high, 2 for moderate, and 1 for low, for example) and you notice that several criteria have the same score for all three of your alternatives, then obviously these criteria are not influencing the final outcome. You may choose to leave them in the analysis

anyway to demonstrate that wildlife (or another resource value) was considered, even though the wildlife rankings (scores) don't change from one alternative to another, but it would actually be better to drop these unvarying criteria because doing so could add additional focus and clarity to your analysis.

Tip: Consider using two filters if you have quite a few evaluation criteria – the first filter is based on total scores, and if they don't identify a clear 'winner,' then the second filter uses a prioritized subset of criteria to help separate an alternative from the rest of the pack. [Note: if weighting factors are used, a second filter is unnecessary because differing weights are then used to prioritize the evaluation criteria.]

Tip: Set up your evaluation criteria in such a way to help your analysis. Using too many criteria, or scoring them so you end with total scores very close to each other, will force you to bring in other considerations when identifying a preferred alternative. I would view this outcome as a 'warning sign' – while on the one hand, you don't want to base your selection of a recommended alternative exclusively on the total scores, but on the other hand, if scores are too close to clearly identify a winner, then the analysis process is basically forcing you to set the evaluation criteria aside (and you worked hard to develop them) and identify a recommended alternative by using other factors.

Tip: Two recent Field Notes from the Western Journal of Applied Forestry are included as appendixes 1 and 2 of this white paper because they offer helpful guidance about silvicultural alternatives and how to evaluate them. Both papers were prepared with the certified silviculturist in mind, but they deal more with alternatives and the NEPA process, not so much with alternatives and the panel process.

8. **To be successful, you must have clear and unambiguous management direction**. Often, the NEPA process will not yet be complete for a larger planning area containing your stand. In this instance, you will need to find another source for management direction because it cannot come from an approved EA or EIS.

   Tip: Ask the District Ranger or line officer to provide you with a letter containing detailed objectives. Be sure the objectives are specific and preferably measurable; broad 'motherhood and apple pie' statements about keeping the forest green and growing might sound nice for a public field trip, but they won't provide enough detail to meet your certification needs.

   Tip: You might want to help the Ranger prepare the letter, or at least be sure to review a draft version and provide feedback about whether the letter contains enough detail to meet your certification prescription needs. Appendix 3 provides an example of a District Ranger management direction letter.

9. **Please be careful in your use of silviculture terminology**. For example, will you be clear in your document about the difference between silvicultural systems and cut-

ting methods? According to long-standing national direction, we only have three silvicultural systems: even-aged management, two-age management, and uneven-aged management. Each of these systems includes one or more regeneration cutting methods (such as clearcutting, seed-tree cutting, shelterwood cutting, etc.), and one or more intermediate cutting methods (such as commercial thinning, improvement cutting, etc.).

This caution may sound like much ado about nothing, but referring to the clearcutting silvicultural system (instead of the clearcutting regeneration cutting method, or just the clearcutting method) might excite the terminology 'wonk' on your panel, and there's really no reason for this to occur. And because certification panels generally include two silviculturists – one serving as panel chair and another as a peer silviculturist – you can pretty much expect every panel to have at least one terminology wonk who will closely scrutinize how you use silvicultural terminology.

Tool: The Forest Service used to maintain its own version of silviculture terminology (in either the Manual or Handbook systems). Thankfully, this is no longer true because we adopted the source used by forestry as a whole – our terminology is now based on the Society of American Foresters "Dictionary of Forestry" book (Helms 1998). As you prepare your prescription, it would be wise to consult the Helms (1998) source often.

Tip: Review the Forest Service 2400 Manual, chapter 2470 (Silvicultural Practices), for national direction regarding terminology. Actual coding for silvicultural activities (cutting methods and other cultural practices), along with short definitions, are contained in Appendix B of the FACTS User Guide.

Philosophical Point: I personally don't believe proper use of silvicultural terminology to be much ado about nothing (to quote Shakespeare) because one of the hallmarks of a consummate practitioner is correct, precise, and consistent use of their profession's nomenclature. If we can't expect certified silviculturists to use silvicultural terminology correctly, then who will?

10. **Finally, here is a perspective from an employee who recently completed the certification process**.

"The best thing I can offer is that each person should enter the certification process with the mindset that it is a long term learning process, not an end game. No matter what you do to "play the certification game"…if your end goal is just to be 'certified,' it won't be worth it. Each session and every hour you spend on you project should be viewed as training, and you make it worthwhile for yourself because no one else can. The actual panel is there (should be there) to help you learn how to be a better silviculturist, partially by tearing you down in your weakest spots. Be prepared to fail or get sent back for major edits, and try again. The certification in

my view is just saying that you can and are willing to learn, and that you can withstand and flourish under professional critique and criticism."

I really appreciate these insights because they convey that 'getting certified' is most assuredly your short-term objective, **but the secret to a successful career is to become a life-long learner**.

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Appendix 1: Long et al. 2010 Journal Paper

FIELD NOTE

Developing and Comparing Silvicultural Alternatives: Goals, Objectives, and Evaluation Criteria

James N. Long, Frederick W. Smith, and Scott D. Roberts

ABSTRACT

We outline an approach for developing and comparing silvicultural alternatives. The approach has multiple advantages, including explicit links between goals, management approaches, and outcomes; efficient development of alternative means of accomplishing the goals; and effective communication of potential tradeoffs between both objectives and alternatives.

Keywords: silviculture, alternatives, Forest Vegetation Simulator, fire metrics

Silviculture is long past the time when it was applied exclusively to meet timber management goals (Guldin and Graham 2007). Silviculturists often find themselves developing plans for projects with multiple and sometimes ambiguous goals involving a broad range of resources and values. Development of silvicultural alternatives should begin with careful characterization of the goals–objectives–evaluation criteria hierarchy. Goals relate to general management direction, objectives represent more precise characterizations of general goals, and evaluation criteria are even more focused and specific with respect to desired outcomes. We suggest an approach that has multiple advantages, including explicit links between goals, management approaches, and outcomes; efficient development of alternative means of accomplishing the goals; and effective communication of potential tradeoffs between both objectives and alternatives.

From Goals to Objectives to Evaluation Criteria

Goals for a given project might come from a variety of sources. For example, they might come from established law or policy; from general management direction, such as standards or guidelines in a forest planning document; from the purpose and need statement for a proposed project, as required by the National Environmental Protection Act of 1969; or from private landowners' broad expectations for their forests. Regardless of their origin, goals are typically general and qualitative (e.g., "enhancing big game winter range" or "reducing risk of bark beetle infestation").

For each stated goal, one or more objectives must be derived. In this context, an objective is a concrete statement that is, in effect, an interpretation of a goal. Objectives should be specific, measurable, achievable, and time bound.

The next step is specifying evaluation criteria for each objective. These are indicators of whether an objective can reasonably be expected to be met by a given management approach (i.e., an alternative). An evaluation criterion, sometimes referred to as an evaluative or effectiveness indicator (Rempel et al. 2004), can be binomial or a continuous variable with a threshold identified as indicative of meeting the objective. Often it is the specification of evaluation criteria that makes objectives quantitative with respect to time and condition and allows effective comparison of alternatives. For each objective, there should be a few (e.g., one to three) well-chosen evaluation criteria that will highlight how alternatives differ with respect to the objective. In our experience, difficulty in specifying evaluation criteria is often a flag indicating that the objective may have been inappropriately characterized and needs to be reconsidered.

Developing and Comparing Silvicultural Alternatives

Development of alternatives should begin with consideration of clearly different approaches for accomplishing the management objectives. For example, an objective relating to future fire behavior might potentially be accomplished with prescribed burning, mechanical treatment, or some combination of the two. For a given basic alternative, there can be variations in the approach to management, e.g., variations in the timing and intensity of a treatment such as thinning. The effects of these variations are evaluated and a preferred system developed within the general framework of that basic alternative. This system will be compared with the best of the systems for other alternative approaches to management. The alternatives, and variations thereof, are individually assessed and compared with each other with respect to the evaluation criteria. Typically, it is necessary to project stand structure and composition into the future for each of the alternatives. Although these projections do not have to be perfect, they do have to be reasonable with respect to the basic elements of the analysis represented by the evaluation criteria.

Graphics are a valuable aid in comparing alternatives, and they should be integral to both the analysis of alternatives and the presentation of results to others. Well-designed graphics focus attention

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on the evaluation criteria and make differences between alternatives explicit with respect to various objectives.

We illustrate this process with an abbreviated example based on a mature second-growth, mixed-conifer stand in the Sierra Nevada Mountains of northern California. Simulations of stand dynamics are based on current stand exam data, including surface fuels. We use the Western Sierra Nevada variant of the Forest Vegetation Simulator (FVS) to simulate each alternative over a reasonable planning horizon (i.e., 50 years). In addition to conventional yield metrics (e.g., volumes, stand and stock tables), FVS is associated with a number of extensions and postprocessors that facilitate comparison of alternatives with respect to, for example, wildlife habitat suitability, hazard ratings for insects or wildfire, and predicting losses from fire and insects (Dixon 2002). The Stand Visualization System extension of FVS can also be effective in communicating important differences between alternatives. Once FVS is initialized for a stand, preliminary screening of an array of alternatives can be done rapidly. The most promising alternatives can then be examined in greater detail with respect to the various evaluation criteria and modified as necessary.

The goals for management of this stand are paraphrased from a project purpose and need statement:

1. Forest vegetation and fuels structure will result in fire behavior in which crown fire is unlikely.
2. The area will consist of healthy stands in which high rates of tree mortality are unlikely.
3. Opportunities will be captured to use activity receipts to offset project costs.

A key step in developing and comparing alternatives is the translation of each of these general goals into focused objective statements associated with specific evaluation criteria. The following objective is an explicit interpretation of the general goal to reduce fire hazard:

Objective 1

Create and maintain fuel profiles and loadings to minimize risk of crown fire under severe fire weather (e.g., 95th percentile).

Evaluation Criterion

Torching index greater than 27 mph.

The second goal concerns reducing the risk of catastrophic loss, which for this stand would most likely result from a mountain pine beetle (*Dendroctonus ponderosae* Hopkins) outbreak or stand replacing fire:

Objective 2A

Maintain relative stand density to reduce the likelihood of a mountain pine beetle outbreak.

Evaluation Criterion

Stand density index (SDI) <250.

Objective 2B

Create and maintain stand structure and fuels profile to reduce the likelihood of stand replacing fire under severe fire weather (95th percentile).

Evaluation Criterion

Mortality <50% of stand basal area.

The third goal has to do with economic efficiency:

Objective 3

Use silvicultural activities to provide commercial wood products.

Evaluation Criterion

Removals >1,000 ft^3/ac.

The goals, as is typical, are qualitative and broad. The objectives are more focused and, when coupled with the evaluation criteria, are quantitative with respect to conditions that can be assessed over time. Obviously, there is considerable flexibility in specifying the criteria by which objectives will be evaluated. We are not suggesting "shopping" for evaluation criteria so as to favor a priori one alternative over another. Rather, we acknowledge there may be more than one appropriate metric by which an objective can be assessed. For example, we used estimates of torching index to quantify the risk of crown fire. Instead, or in addition, we could have chosen an evaluation criterion directly reflecting the fuel profile (i.e., canopy base height). Similarly, with respect to the objective relating to bark beetle activity, we could have chosen to evaluate alternatives using a mountain pine beetle risk rating instead of the more generic stand density index.

Effective evaluation criteria serve to keep the analysis of alternatives focused, and their rationale should be briefly explained and supported with appropriate citations. For example, the evaluation criterion specifying torching index greater than the critical wind speed of 27 mph would be explained on the basis of the weather data and assumptions from which it was derived. It would be noted, for example, that values of torching index that "are multiple times the magnitude of any possible wind speed … [are] characteristic of a forest structure that is extremely resistant to passive crown fire" (Stephens et al. 2009). The threshold criterion of SDI < 250 associated with the objective relating to mountain pine beetle would be supported with a reference to Oliver (1995) or Long and Shaw (2005).

In our example, we include four evaluation criteria. Each alternative must be evaluated against each of these criteria over a reasonable length of time (e.g., 50 years). Ideally, at least one of the alternatives will meet all of the objectives, as indicated by the evaluation criteria. Of course, that does not always happen and, in fact, it is not unusual for some objectives to be mutually exclusive. Realistic projections of stand development in response to treatments allow assessment of how constraints, such as prohibiting removal of trees greater than an arbitrary diameter or restricting use of prescribed fire, might affect the accomplishment of objectives. The exposure of such inconsistencies early in project development is indeed an important value of systematically articulating objectives, specifying evaluation criteria, and developing alternatives that can be judged objectively with respect to the goals. Typically, it is not the role of the silviculturist to set goals or even to prioritize them; however, the silviculturist does have a key role in the evaluation and characterization of potential resource tradeoffs. When inconsistencies are exposed, the process can help focus attention on the goals, e.g., Are they realistic? Are they equally important? The silviculturist can and should evaluate and make explicit for the decisionmaker the important tradeoffs associated with incompatible goals and objectives.

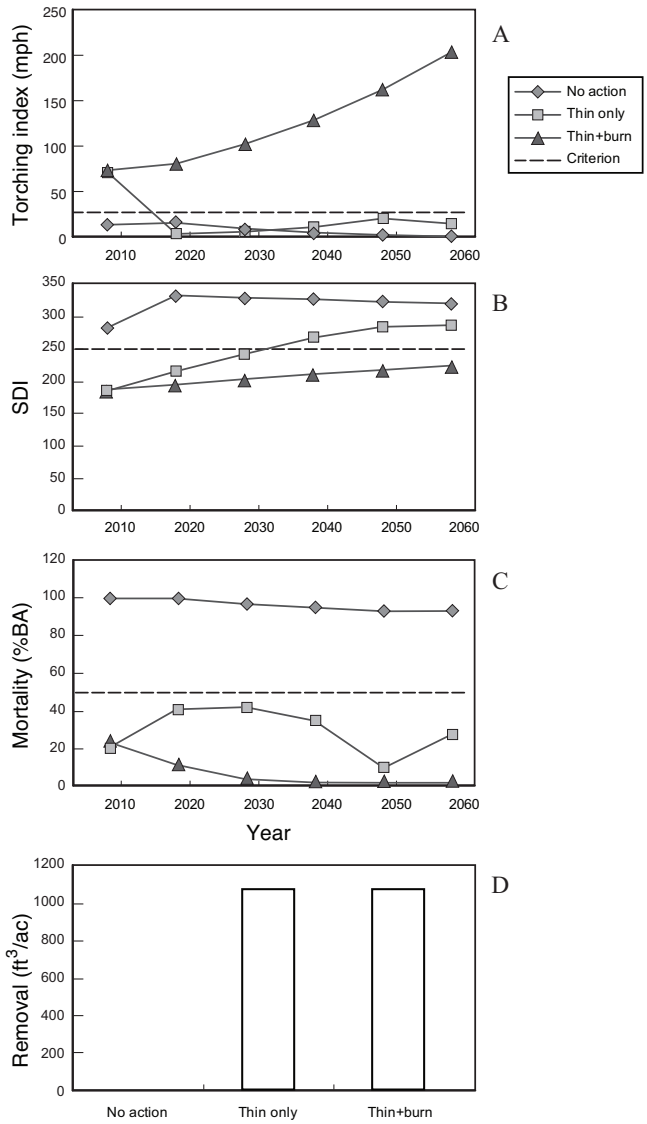

Figure 1. Comparison of three alternatives with respect to evaluation criteria: (A) torching index >27 mph; (B) stand density index (SDI) < 250; (C) mortality <50% of stand basal area (%BA); (D) removals >1,000 ft^3/ac.

To illustrate the process, we have developed and simulated three alternatives with FVS and its Fire and Fuels Extension. The first is the requisite no-action alternative. The second (thinning only) incorporates a thinning-from-below to remove fuel ladders and reduce overstory density. The third (thinning plus prescribed fire) superimposes prescribed fire every 10 years on the thinning-only alternative.

Figure 1 displays how each of the alternatives is expected to perform over time with respect to the evaluation criteria. It is obvious that the no-action alternative meets none of the objectives. It is also clear, for example, that the thinning-only alternative meets all of the evaluation criteria in the short term; however, periodic retreatment is needed to meet the objectives over time. Thinning followed by periodic prescribed fire is the only alternative that meets all objectives over the entire 50-year time frame.

For some projects, it is necessary to develop and compare alternatives for a complete silvicultural system (e.g., an entire even-aged rotation or many cutting cycles of an uneven-aged system). In these cases, the appropriate planning horizon would necessarily be much longer than the 50-year time frame used in our example involving intermediate treatment(s) of an existing stand.

Summary

Silviculturists face complex challenges in developing prescriptions to achieve multiple goals and objectives. At times, conflicting management direction may make it impossible to simultaneously or continuously meet all of the goals and objectives. Silviculturists should attempt to identify these conflicts, as well as trade-offs between feasible alternatives, as early in the planning process as possible.

The systematic development of a silvicultural system, beginning with careful and explicit characterization of the goals–objectives–evaluation criteria hierarchy, is an effective way to identify challenges and ambiguities in management objectives. Simulation of alternatives (e.g., with FVS) allows comparison of alternatives over time with respect to the evaluation criteria. Graphics can make differences between alternatives apparent. This approach greatly facilitates development and comparison of alternatives. We are not proposing this process as a decisionmaking system; however, its outcomes can be used in support of many of the decisionmaking frameworks used in natural resource management.

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Appendix 2: Long and Kurtzman 2012 Journal Paper

FIELD NOTE

What Makes a Range of Silvicultural Alternatives Reasonable?

James N. Long and Judith A. Kurtzman

ABSTRACT

For any proposed vegetation management, there are considerable benefits to exploring a broad range of alternatives that might accomplish the management goals. We outline a practical and defensible process that silviculturists can use when developing and documenting a reasonable range of silvicultural alternatives for accomplishing stand management objectives.

Keywords: goals, objectives, silviculture

The implementation of a silvicultural prescription in a stand is one part of a process that begins with the identification of management goals for the stand and includes careful consideration of alternative approaches that might accomplish those goals. For every silviculturist, considering a reasonable range of alternatives is a professional obligation, and indeed, for silviculturists involved in vegetation management on federal lands, it is a legal requirement. But what constitutes a reasonable range of silvicultural alternatives? At a minimum, the silviculturist will assess a no-action alternative and one action alternative. The no-action alternative is associated with the effects on resources and ecosystem processes resulting from the continuation of current management practices or not moving forward on a proposed action. A fairly common situation is one where the silviculturist must consider whether stand management objectives for a mature stand could be accomplished by one of the following: deferring management for the time being, regenerating the stand immediately, or maintaining it as a mature stand with the implementation of intermediate treatments. This situation would result in at least three alternatives: the no-action alternative, a regeneration alternative (e.g., regeneration cut of a shelterwood), and an intermediate treatment alternative (e.g., involving thinning or prescribed fire). This example includes only an absolute minimum number of alternatives; it does not address what might constitute a reasonable range of alternatives.

One of the most common challenges of National Environmental Policy Act of 1969 (NEPA) documents is that they have failed to assess a reasonable range of alternatives, and unfortunately this argument is one that plaintiffs often win in court (Smith 2007). One of those court decisions (*Simmons v U.S. Army Corps of Engineers* 1997) established a logical process for determining a reasonable range of alternatives. The so-called Simmons Framework consists of three steps or questions that must be addressed in sequence: (1) what is the purpose (i.e., objectives) of the project? (2) given the objectives, what are the reasonable alternatives? and (3) to what extent must a particular alternative be developed? The framework is discussed in detail in Czarnezki (2003) and *Habitat Education Center, Inc., v. U.S. Forest Service* (2009). The Simmons Framework applies specifically to NEPA-based analysis. However, the basic framework can be usefully interpreted in the context of stand-specific alternative development.

In this article, we outline a structure for developing and documenting a reasonable range of silvicultural alternatives for accomplishing stand management objectives. Identifying reasonable alternatives is, of course, an important precursor to the selection of a given alternative and the eventual development and implementation of a stand-specific silvicultural prescription. We provide silviculturists with a practical and defensible process for efficiently exploring alternatives in the context of stand management goals, objectives, and evaluation criteria.

Framework for a Reasonable Range of Alternatives

Identification of Objectives

The structure has as its starting point the approach outlined by Long et al. (2010) for developing and comparing silvicultural alternatives. This approach explicitly links broad goals with specific objectives and management approaches for accomplishing the goals. Goals for the management of a given stand can come from a variety of sources, for example from the employer or directly from the landowner. Goals are almost always general. An example of a typically broad goal might be to make "high rates of tree mortality unlikely." Although the silviculturist does not create the goals, each goal must be interpreted with one or more focused objectives. For example, for a particular stand, this goal might mean building and maintaining resistance to losses due to mountain pine beetle (MPB). For another stand and management situation, this broad goal might relate to the risk of stand-replacing fire. For another stand, the goal might relate to both MPB and fire. In any case, the silviculturist will develop focused objectives, reflecting the differences in management context (Long et al. 2010). Each objective is in turn associated with evaluation criteria, which are indicators of whether the objective can reasonably be expected to be met. The evaluation criteria

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have to be measurable, as they are the basis for developing, comparing, and selecting alternatives and, eventually, are the standard for determining success (Freeman 2010).

Objectives should not be defined too narrowly. An indicator of this would be when the objective is in fact an alternative. In other words, the too-narrow objective goes straight to *how* the goal should be accomplished (e.g., "thin from below to reduce stand basal area to 60 ft^2/ac"). This objective appropriately specifies the desired condition (i.e., a target relative density) but inappropriately specifies how the desired condition would be achieved and, therefore, precludes any alternative approaches. Conversely, objectives should not be so broad as to lose their context. For example, in the absence of stand specificity, objectives such as "maintaining forest health" or "restoring resilience" are essentially meaningless.

In the example presented by Long et al. (2010, p. 97), there were three fairly broad management goals. Each goal was then characterized with one or more objectives and evaluation criteria specific to a particular stand:

Goal: Forest vegetation and fuels structure will result in fire behavior in which crown fire is unlikely.

Objective: Create and maintain fuel profiles and loadings to minimize risk of crown fire under severe fire weather (95th percentile).

Evaluation criterion: Torching index greater than 27 mph.

Goal: The area will consist of healthy stands in which high rates of tree mortality are unlikely.

Objective: Maintain relative stand density to reduce the likelihood of a mountain pine beetle outbreak.

Evaluation criterion: Stand density index (SDI) <250.

Objective: Create and maintain stand structure and fuels profile to reduce the likelihood of stand replacing fire under severe fire weather (95th percentile).

Evaluation criterion: Mortality $<50\%$ of stand basal area.

Goal: Opportunities will be captured to use activity receipts to offset project costs.

Objective: Use silvicultural activities to provide commercial wood products

Evaluation criterion: Removals $>1{,}000$ ft^3/ac.

Characterizing general management goals in terms of explicit, unambiguous objectives is a critical step in developing a reasonable range of silvicultural alternatives.

Associating Objectives with Alternatives

Eventually, each of the identified objectives must be explicitly linked to at least one alternative, and a given alternative must be associated with one or more of the objectives. As alternative development proceeds, there will likely be multiple alternatives associated with a given objective, but obviously, each objective must have at least one associated alternative. Note, the identified alternatives are not represented by silvicultural prescriptions but rather by characterizations of an approach (e.g., establishment cut of a shelterwood, low thinning, prescribed burn).

It is important not to get stuck in an intellectual cul-de-sac of assuming there can only be one approach for each of the objectives. Similarly, the silviculturist should not assume that there will be only a single alternative for any given objective. This was true in the 1960s, at least in some parts of the western United States, where foresters commonly went straight to what was essentially the default, and only, alternative: clearcut and plant. Sometimes this was modified to include prescribed burning prior to planting. By the 1980s, of course, things had changed considerably, and foresters would joke that wildlife biologists invariably went straight to the no-action alternative. To the extent that the second example of a default single alternative was actually true, we suspect it was in no small part a reaction to the earlier, pre-NEPA, single-alternative situation.

When beginning the process of identifying alternatives, consideration should be given to clearly different approaches for accomplishing the management objectives (Long et al. 2010). An objective relating to future fire behavior might potentially be accomplished with prescribed burning, mechanical treatment, or some combination of the two. In this case, we argue that the analysis should include at least one alternative representing each of the basic approaches. Also, for a given basic alternative there may be substantive variations, such as differences in the timing and intensity of a treatment like prescribed burning. It is also appropriate at this stage in the process to consider potential "show stoppers." An example of a show stopper might be policy to the effect that a particular approach, e.g., prescribed fire, is not permissible. Even where policy precludes a particular approach, it is appropriate to include this approach as an "alternative considered but eliminated," with a brief explanation of why the alternative was not developed (Czarnezki 2003, CEQ Regulation 1502.14).

The process continues until each objective is associated with at least one alternative, and typically more than one alternative. At this point, no single alternative will necessarily meet all of the objectives. It is inappropriate to disregard an alternative because it does not offer a complete solution (Czarnezki 2003). In fact, we suggest the silviculturist not worry about finding the perfect alternative right from the beginning of the process but initially think about the objectives more or less independently. In the example from Long et al. (2010), the objectives relating to manipulation of the fuel profile and relative density could reasonably be associated with a mechanical treatment alternative, as well as a prescribed burn alternative. In contrast, the objective relating to commercial harvest could be achieved only by mechanical treatment.

The process should not be a burden. The alternatives associated with the objectives are not detailed; they are, along with no action, simple characterizations of silvicultural interventions that the silviculturist believes should logically be acknowledged. The process should focus analysis on just those alternatives that best achieve all of the objectives, while eliminating the remainder from further analysis.

A Test of Reasonableness

The list of objectives and associated alternatives represents a litmus test. Clearly, if at this point each objective is not explicitly linked with one or more potentially viable alternatives, then the tentative range of alternatives fails the reasonableness test and must be expanded. This needs to be taken a step further to the effect that each objective should be associated with at least one alternative that, if implemented, can reasonably be expected to accomplish that objective. We contend this step is at the heart of testing for a reasonable range of alternatives.

At this point in the process, the silviculturist can begin assessing what sort of overlap exists between objectives and alternatives. The ideal, of course, is to have at least one alternative associated with the entire list of objectives. If not, can any of the existing alternatives be modified or combined, or can a new alternative be identified, so as to be legitimately associated with all of the objectives? It sometimes is the case that no alternative can realistically be expected to accomplish all the objectives. Such a situation might result from the way objectives have been characterized; it might also be indicative of some fundamental incompatibility of goals (Long et al. 2010). Identifying potential inconsistencies and recognizing their causes are important arguments for carefully characterizing the objectives and a reasonable range of alternatives to meet them.

Documenting the Process

It is important to explicitly identify and summarize the thought process and decisions leading to the association of alternatives with the stand management objectives. It is especially important to explain, in a sentence or two, why some alternatives were considered but eliminated. Freeman (2009, p. 7) admonishes ". . . not to be silent about the reasons for considering some alternatives and ignoring others. Silence is a gift to a possible plaintiff."

A key part of documenting the process will, of course, be the fact that each objective has been associated with at least one alternative. There should also be explicit recognition of any special situation, such as specific policy direction, that influences the range of alternatives. An example of this would be the requirement for a minimum residual canopy cover such as might exist if the stand is in a northern spotted owl Protected Activity Center (PAC). This requirement would preclude eventual development of an alternative involving clearcutting in the PAC, even if such an alternative might otherwise accomplish one or more of the stand management objectives. It is important, however, to make this reasoning clear and to identify factors that caused an alternative to be put into the category of "alternatives considered but eliminated."

There are certainly many situations where the silviculturist, even if working on federal lands, may not be technically required to develop what we are characterizing as a reasonable range of alternatives. Our concern is that such a shortcut has real risk, not the least of which is potentially failing to identify the alternative that would most effectively and efficiently meet the stand-management objectives. Our recommendation to silviculturists is to use the procedure we have outlined to both develop and document that a reasonable range of alternatives has been considered.

Summary

The process is explicitly linked to stand management objectives and provides a practical and defensible approach for developing and documenting a reasonable range of silvicultural alternatives. We deliberately avoid suggesting a minimum number of alternatives. This is ultimately a function of the specific objectives associated with a proposed vegetation management. A relatively simple project involving one or two objectives will have fewer considered alternatives than a project involving a broader range of objectives. Additionally, some objectives can be addressed with a single type of silvicultural intervention; for other objectives, however, the silviculturist must consider a broader range of basic approaches (e.g., a fuels objective that might be accomplished by prescribed fire, mechanical treatment, or a combination of the two). Each stated objective must be explicitly associated with at least one alternative that, if implemented, can realistically be expected to accomplish that objective. Finally, the silviculturist should provide a brief rationale for why the list of alternatives does in fact represent a reasonable range of alternatives.

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APPENDIX 3: EXAMPLE OF A MANAGEMENT DIRECTION LETTER

United States Department of Agriculture | **Forest Service** | **Heppner Ranger District** | **P.O. Box 7 Heppner, OR 97836 541-676-9187**

File Code: 2470 **Date:** February 8, 2012
Route To:

Subject: Management Direction for Silviculture Certification Stand

To: Your Name Here

The purpose of this letter is to provide you with management direction for your silviculture certification stand. As discussed, you will be writing a prescription for the Kahler 78 stand, within the Kahler planning area. This stand is within Management Area E1 (Timber and Forage), and falls under Scenario A of the Eastside Screens.

The following resource objectives should be applied to the Kahler 78 stand:

- Promote the development of old forest single stratum (OFSS) structure within the dry upland forest plant association group. Range of variation analysis across the Kahler planning area indicates a lack of OFSS structure. Old forest on the Umatilla National Forest is defined as a minimum of 10 trees per acre ≥ 21" dbh.
- Retain all live trees ≥ 21" dbh and all snags greater than 14" dbh.
- Reduce severe mistletoe infections where possible. Patches of mistletoe infection are valuable for wildlife purposes and can be retained when consistent with the old forest structure objective.
- Reduce the potential for uncharacteristic impacts from wildfire, insects, and diseases.

It is my expectation that your certification prescription will serve as a tool that the newly formed Umatilla National Forest Collaborative Group can use for exploring future treatment options for the Kahler planning area. Given the diverse nature of the group, it is likely they will want to explore new and different options for vegetation treatments. Use the latest science available and explore non-traditional treatments when developing your prescription.

I expect your prescription to be consistent with the goals and objectives for the applicable Forest Plan management area, including Forest-wide standards and guidelines. Additionally, your prescription should be consistent with Eastside Screens. Stewardship authority is available for implementation of your prescription, although an economically viable timber-sale alternative is preferred.

A completion schedule for your certification prescription should be August 2012, with a Forest panel tentatively scheduled for September 2012. I am confident that this timeframe is attainable, and that you will manage your time to complete the prescription without significant effects on your primary work responsibilities. There is a wealth of experience and assistance for you to tap into at both the District and Forest offices.

APPENDIX 3: EXAMPLE OF A MANAGEMENT DIRECTION LETTER

Please contact Dave Powell, the Forest Silviculturist, to validate the plan to develop the prescription, schedule a Forest panel, and complete the certification process. If you have any questions, feel free to follow up with me.

/S/ Smokey T. Bear
SMOKEY T. BEAR
District Ranger

APPENDIX 4: SILVICULTURE WHITE PAPERS

White papers are internal reports, and they are produced with a consistent formatting and numbering scheme – all papers dealing with Silviculture, for example, are placed in a silviculture series (Silv) and numbered sequentially. Generally, white papers receive only limited review and, in some instances pertaining to highly technical or narrowly focused topics, the papers may receive no technical peer review at all. For papers that receive no review, the viewpoints and perspectives expressed in the paper are those of the author only, and do not necessarily represent agency positions of the Umatilla National Forest or the USDA Forest Service.

Large or important papers, such as two papers discussing active management considerations for dry and moist forests (white papers Silv-4 and Silv-7, respectively), receive extensive review comparable to what would occur for a research station general technical report (but they don't receive blind peer review, a process often used for journal articles).

White papers are designed to address a variety of objectives:

(1) They guide how a methodology, model, or procedure is used by practitioners on the Umatilla National Forest (to ensure consistency from one unit, or project, to another).
(2) Papers are often prepared to address ongoing and recurring needs; some papers have existed for more than 20 years and still receive high use, indicating that the need (or issue) has long standing – an example is white paper #1 describing the Forest's big-tree program, which has operated continuously for 25 years.
(3) Papers are sometimes prepared to address emerging or controversial issues, such as management of moist forests, elk thermal cover, or aspen forest in the Blue Mountains. These papers help establish a foundation of relevant literature, concepts, and principles that continuously evolve as an issue matures, and hence they may experience many iterations through time. [But also note that some papers have not changed since their initial development, in which case they reflect historical concepts or procedures.]
(4) Papers synthesize science viewed as particularly relevant to geographical and management contexts for the Umatilla National Forest. This is considered to be the Forest's self-selected 'best available science' (BAS), realizing that non-agency commenters would generally have a different conception of what constitutes BAS – like beauty, BAS is in the eye of the beholder.
(5) The objective of some papers is to locate and summarize the science germane to a particular topic or issue, including obscure sources such as master's theses or Ph.D. dissertations. In other instances, a paper may be designed to wade through an overwhelming amount of published science (dry-forest management), and then synthesize sources viewed as being most relevant to a local context.
(6) White papers function as a citable literature source for methodologies, models, and procedures used during environmental analysis – by citing a white paper, specialist reports can include less verbiage describing analytical databases, techniques, and so forth, some of which change little (if at all) from one planning effort to another.
(7) White papers are often used to describe how a map, database, or other product was developed. In this situation, the white paper functions as a 'user's guide' for the new product. Examples include papers dealing with historical products: (a) historical fire extents for the Tu-

cannon watershed (WP Silv-21); (b) an 1880s map developed from General Land Office survey notes (WP Silv-41); and (c) a description of historical mapping sources (24 separate items) available from the Forest's history website (WP Silv-23).

The following papers are available from the Forest's website: Silviculture White Papers

Paper #	Title
1	Big tree program
2	Description of composite vegetation database
3	Range of variation recommendations for dry, moist, and cold forests
4	Active management of dry forests in the Blue Mountains: silvicultural considerations
5	Site productivity estimates for upland forest plant associations of the Blue and Ochoco Mountains
6	Fire regimes of the Blue Mountains
7	Active management of moist forests in the Blue Mountains: silvicultural considerations
8	Keys for identifying forest series and plant associations of the Blue and Ochoco Mountains
9	Is elk thermal cover ecologically sustainable?
10	A stage is a stage is a stage…or is it? Successional stages, structural stages, seral stages
11	Blue Mountains vegetation chronology
12	Calculated values of basal area and board-foot timber volume for existing (known) values of canopy cover
13	Created opening, minimum stocking level, and reforestation standards from the Umatilla National Forest land and resource management plan
14	Description of EVG-PI database
15	Determining green-tree replacements for snags: a process paper
16	Douglas-fir tussock moth: a briefing paper
17	Fact sheet: Forest Service trust funds
18	Fire regime condition class queries
19	Forest health notes for an Interior Columbia Basin Ecosystem Management Project field trip on July 30, 1998 (handout)
20	Height-diameter equations for tree species of the Blue and Wallowa Mountains
21	Historical fires in the headwaters portion of the Tucannon River watershed
22	Range of variation recommendations for insect and disease susceptibility
23	Historical vegetation mapping
24	How to measure a big tree
25	Important insects and diseases of the Blue Mountains
26	Is this stand overstocked? An environmental education activity
27	Mechanized timber harvest: some ecosystem management considerations
28	Common plants of the south-central Blue Mountains (Malheur National Forest)
29	Potential natural vegetation of the Umatilla National Forest
30	Potential vegetation mapping chronology

Paper #	Title
31	Probability of tree mortality as related to fire-caused crown scorch
32	Review of the "Integrated scientific assessment for ecosystem management in the interior Columbia basin, and portions of the Klamath and Great basins" – forest vegetation
33	Silviculture facts
34	Silvicultural activities: description and terminology
35	Site potential tree height estimates for the Pomeroy and Walla Walla ranger districts
36	Tree density protocol for mid-scale assessments
37	Tree density thresholds as related to crown-fire susceptibility
38	Umatilla National Forest Land and Resource Management Plan: forestry direction
39	Updates of maximum stand density index and site index for the Blue Mountains variant of the Forest Vegetation Simulator
40	Competing vegetation analysis for the southern portion of the Tower Fire area
41	Using General Land Office survey notes to characterize historical vegetation conditions for the Umatilla National Forest
42	Life history traits for common conifer trees of the Blue Mountains
43	Timber volume reductions associated with green-tree snag replacements
44	Density management field exercise
45	Climate change and carbon sequestration: vegetation management considerations
46	The Knutson-Vandenberg (K-V) program
47	Active management of quaking aspen plant communities in the northern Blue Mountains: regeneration ecology and silvicultural considerations
48	The Tower Fire…then and now. Using camera points to monitor postfire recovery
49	How to prepare a silvicultural prescription for uneven-aged management
50	Stand density conditions for the Umatilla National Forest: a range of variation analysis
51	Restoration opportunities for upland forest environments of the Umatilla National Forest
52	New perspectives in riparian management: Why might we want to consider active management for certain portions of riparian habitat conservation areas?
53	Eastside Screens chronology
54	Using mathematics in forestry: an environmental education activity
55	Silviculture certification: Tips, tools, and trip-ups
56	Vegetation polygon mapping and classification standards: Malheur, Umatilla, and Wallowa-Whitman national forests
57	The state of vegetation databases on the Malheur, Umatilla, and Wallowa-Whitman national forests

REVISION HISTORY

February 2014: minor formatting and text edits were made throughout; and new appendixes were added (appendixes 1-3).