WHITE PAPER

USDA Forest Service Pacific Northwest Region Umatilla National Forest

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

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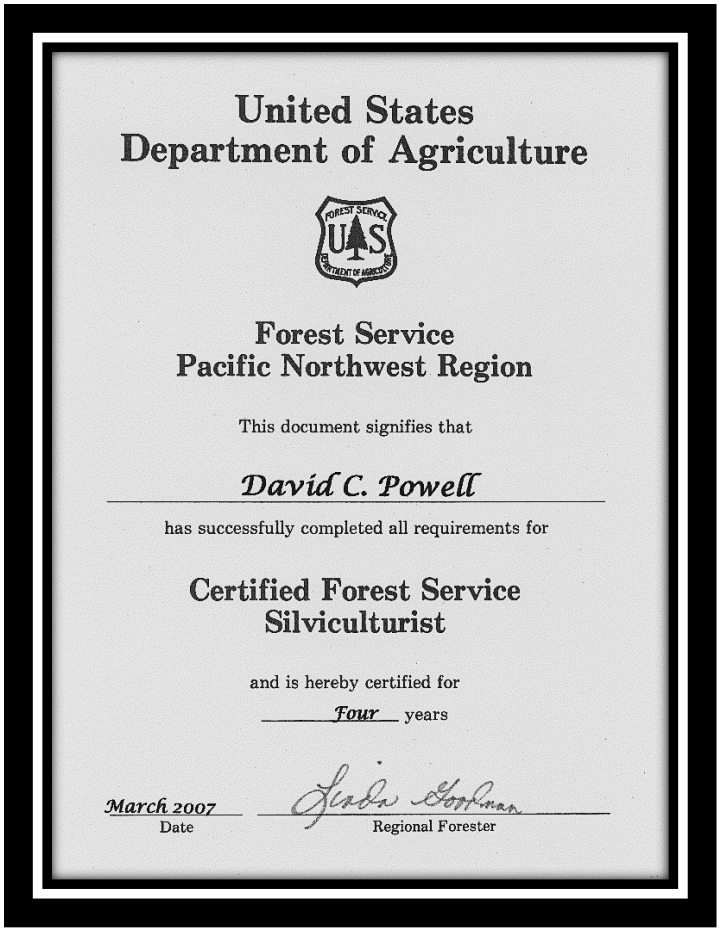

United States
Department of Agriculture

Forest Service
Pacific Northwest Region

This document signifies that

David C. Powell

has successfully completed all requirements for

Certified Forest Service
Silviculturist

and is hereby certified for

Four years

March 2007
Date

Regional Forester

[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 USDA Forest Service.

INTRODUCTION

Between 2010 and 2014, I had the pleasure of being directly involved with eight certification panels – six Regional panels and two Forest panels.

This white paper includes twelve themes gleaned from recent panel experiences. After identifying a theme, I provide ideas for how to respond to it –

- **tips** (strategies for success, gathered from recent panels),
- **tools** (methodologies, procedures, and techniques for silviculture certification),
- **trip-ups** (situations to avoid for a successful certification outcome).

1. **Pick a certification stand wisely.** Virtually everything in the certification process is influenced by your selection of a stand – pick sensibly, and the rest of your process benefits from your good judgment. Pick poorly, and all subsequent steps will be more difficult than need be.

   What should you think about when selecting a stand? Since this is an important decision, here is quite a bit of detail to consider:

   Objective of stand selection process. A certification panel uses your written document, your oral presentation, and your response to oral questioning to determine if you have correctly applied and integrated silvicultural concepts and principles. For a panel to make this determination properly, a stand you select must be complex enough, in terms of management objectives and stand characteristics, to demonstrate your proficiency in applying and integrating silvicultural concepts and principles (i.e., demonstrating you are a journey-level silviculturist). Beginning silviculturists are not expected to handle the most challenging circumstances, but you must be able to integrate several (generally less than half a dozen) management objectives and resource concerns into a treatment prescription for typical forest compositions, structures, and stand densities.

   Tip: Pick a single stand encompassing 10 to 100 acres in size, depending on local context. Stands less than 10 acres are unlikely to provide enough management complexity for certification purposes. Stands of 100 acres or more are likely to include too much variation in site condition, generally resulting in more analysis complexity than you'll want to handle.

   a) **How many species should your stand include?** Species composition is an important factor to consider when evaluating stand complexity. A stand you choose should contain two or more common tree species in reasonable proportions (a 2nd species shouldn't be so limited that it never influences the silvicultural alternatives you're considering).

Trip-Up: Picking a stand with too many species may introduce more complexity than you want to deal with. Selecting a stand with only one species (e.g., lodgepole pine or climax ponderosa pine) may not provide enough complexity to demonstrate your proficiency with silvicultural concepts and principles.

b) How much biophysical complexity should you include? Selecting a stand with extreme levels of root disease, dwarf mistletoe, or bark beetles may unduly limit the scope of silvicultural alternatives you should reasonably consider. Avoid these stands, especially when there is more than one insect or disease at high levels! [Some level of biotic impact is fine, but avoid stands with too much.]

Trip-Up: A similar caution applies to physical factors – don't select a stand with a high proportion of riparian habitat, unusually steep slopes, or other limitations (again, some amount of site variation is fine, but avoid too much).

[In extreme cases, high variation results in two prescriptions being prepared for a single polygon – one Rx for condition A, and another for condition B. If you reach a point where you feel like your stand is 'dictating' two prescriptions, then treat this as a possible tip-off that your stand boundary needs to be adjusted. And at that point, ask yourself this question: Am I really dealing with two stands?]

c) How much statutory or planning complexity should you include? While it may seem so obvious that stating it here is unnecessary –

Tip: Don't select a stand in a designated Wilderness area, or in a similar Forest Plan management allocation, that would substantially curtail your opportunity to consider a reasonably wide range of silvicultural alternatives.

Pick a stand that provides enough management latitude to develop alternative treatments addressing a reasonably complex suite of goals and objectives.

d) How can you identify stands with too much complexity? There are no hard and fast rules for identifying a 'Goldilocks' level of stand complexity (not too much, not too little, just right). R6/PNW Supplement 2409.17-2011-2 to FSH 2409.17, Silvicultural Practices Handbook, states that "the situation should be one of average complexity" and "your stand is too simple if it has only one issue driving the alternatives, evaluation, or recommendation" (section 8.63). As a starting point, think mostly about operational factors when evaluating complexity.

Tip: Consider this question when evaluating stand complexity – Are site and stand conditions uniform enough to apply one activity or practice (cutting method) across an entire stand area and reasonably expect a consistent silvicultural and ecological response? If not, and if the reason for a 'no' answer to this question is because a stand contains too much variation to permit one management regime (prescription) to be applied, then think about whether a candidate stand includes too much complexity.

[And, while we tend to consider biophysical variation first when making this judgment (by assessing variation in stand characteristics), don't forget to also evaluate other variation sources such as management direction – if half a stand occurs in a management area (MA) allowing timber management, and half in a non-harvest MA, then this circumstance could be a 'deal-breaker,' even if biophysical stand characteristics are consistent across a site.]

e) **Consider certification document sideboards (constraints) when deciding how much complexity to tackle.** According to a recent R6 Handbook Supplement describing certification prescription standards (R6 Supp. 2409.17-2011-2 to FSH 2409.17, dated Aug. 29, 2011), your final prescription document can be no longer than 25 pages (including prescription body, table of contents, tables, graphics, and implementation and monitoring plan), plus one additional page for an executive summary (26 pages total for body plus executive summary). *There is no page limit for appendix material*.

Your prescription document must be double-spaced, use nothing smaller than 1-inch margins, and its font size must be at least 11 point (10 point allowed for footnotes). (To save space, most certification prescriptions contain a table of contents that is single-spaced, and this is allowed.) These formatting standards are more restrictive than those adopted by other Regions, and they almost always exert a strong influence on an R-6 certification prescription document!

Formatting Tip: Everyone prepares their certification prescription by using MS Word software. I'm amazed at just how many of these documents don't use Word's automatic hyphenation feature (choose Automatic under the Hyphenation menu on Layout tab). May not seem like it makes much difference, but if you're trying to drop half a page to fit within the Region's 26-page standard, turning on automatic hyphenation can really help.

Formatting Tip: Another formatting 'trick' to consider – remove Widow/Orphan control by unchecking it (find this item on Line and Page Breaks menu under Paragraph tab). When a document is double-spaced, Widow/Orphan control exerts even more influence on page content than it does for a single-spaced document. When Widow/Orphan control is turned off, Word can place more text on each page, and it doesn't leave as much white space at the bottom of each page.

Trip-Up: 26 double-spaced pages equates to a 13-page prescription document when considering how a normal single-spaced document is formatted. If you select a complicated stand with many elaborate stories to tell, page limits quickly become constraining. You soon find yourself moving material to an appendix, even important material you wish could be left in the document body. With tight page limits, selecting a simple, straightforward stand (within reason – see items

b to d above) allows you to tell a succinct stand story, while simultaneously improving your chances of a successful certification outcome.

A bottom-line: Remember that complicated stands often lead to 'high-risk' certification panel outcomes. Whenever possible and appropriate, adopt the KIS principle – Keep It Simple!

f) Consider your personal access to the stand. During the process to write a prescription document and prepare for a certification panel, you will spend a lot of time in your stand. Selecting a stand allowing relatively easy and quick access will be a time saver! And, as prescription preparation progresses, there will be instances where stand-specific questions or concerns arise – if you can jump in a rig and visit your stand quickly, then addressing spur-of-the-moment questions or concerns will be that much easier.

[Also, under some circumstances, you may want to consider requesting a field panel instead of an office panel – having easy access to your stand is a real benefit then, too.]

Tip: If possible, and unfortunately it often will not be, select a stand with reasonably good, all-weather access, so you can visit it during fall, winter, and spring, in addition to typically good summer access.

g) Ask your silvicultural mentor for an example prescription to refer to as you prepare your own document. The certification process will be easier to navigate if you have a silviculture 'mentor' to help show you the ropes. A mentor will usually be another silviculturist (a District or zone silviculturist, or a Forest silviculturist, often fills this role), but it could also be a trusted employee like a line officer (District Ranger, staff officer, etc.) or a silviculture mentor provided through the Forest Service's ACES program.

Some material in this white paper, or policy statements in the silviculture certification section of a FS Handbook, may be confusing without an example prescription document to review. Confusing material usually seems clearer after a silviculture mentor provides you with an example prescription document. It goes without saying that your mentor should provide you with a 'good' example document from a successful panel defense, and preferably one identified by the Regional Office as a good example to use.

Tip: A sample prescription document is extremely helpful, at least for most of us who are 'visual' learners and can best comprehend what is needed by looking at an example.

Do not expect to just 'copy' the example for your own document. Always remember that an example is just that – nothing is holding you back from doing more or something new and different, and making it your own.

2. **Seek help if you are not a good writer.** You are not being certified as a writer (some days, it may feel that way), but please try 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 your written document is not professional in appearance or unclear in content or organization, then the balance of your certification process will be 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* (in other words, their skill as a writer and editor is more important than their job position).

3. **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 a document.

   Tip: your final document check should look for logic discrepancies, including number inconsistencies. If your economic analysis uses 10 MBF/acre as a harvest volume, but your FVS printout shows 12 MBF/acre being harvested, then be assured that someone on a 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 'buried' at the back of your document is not scrutinized to a similar extent as 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.]

   Note: I don't offer these comments about cross-checking to establish an impression that panels are petty or 'anal' in their approach. They aren't! But my observations illustrate how thoroughly a panel approaches its responsibility – expect your document to be scrutinized in a more detailed manner than you may be used to.

4. **Use cited literature to support your statements**. While I don't recommend you go overboard (and 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 a district wildlife biologist is both understandable and expected, but if the bulk of your citations end up in this 'personal communication' realm, then a panel will have concerns about your use of the scientific literature (and rightfully so).

   Why be concerned about citing literature? Your certification prescription documents your thought process, and it demonstrates you have knowledge and skills to

function as a journey-level silviculturist. A natural resource professional must be conversant with foundational science ('best available science') for their discipline. If your prescription document contains few science citations, you are conveying, whether you intend it or not, that most of your discussion is based on personal opinions, communications, and judgments, rather than built on a firm science foundation. But when you make a statement, and follow it with a literature citation in parentheses, you are asserting that your declaration not only fits the stand and its circumstances, but it is supported by forestry science as well.

I know there is a body of best available science (BAS) supporting 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). Don't be afraid to share this body of BAS with your prescription readers!

Be sure to include 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 provide rationale for a longleaf pine-eastern Oregon connection.

Tip: Within the page limits established for your prescription document, please include a reasonably deep literature cited section, and be sure it includes 'correct' references – strong, high-quality, peer-reviewed, geographically-relevant science.

If you are unsure about what correct (BAS) references should be, consult other experts – an entomologist assigned to your Forest Health Protection area can provide useful input about BAS for insect susceptibility, for example, and they can help ensure it is locally relevant. Local reports such as watershed analyses or perhaps environmental analysis specialist reports may also be helpful for identifying BAS for your area.

Be discriminating when using other sources such as specialist reports, however, because not all of them have done a good job at identifying locally relevant BAS.

Tip (and a coping strategy): As described earlier in this document, an R6 Handbook Supplement describing certification prescription standards (R6 Supp. 2409.17-2011-2 to FSH 2409.17, dated Aug. 29, 2011), states that your prescription document can be no longer than 25 pages (including prescription body, table of contents, tables, graphics, and implementation and monitoring plan), plus one additional page for an executive summary (*26 pages total for body plus executive summary*).

Note that the Handbook's list of prescription elements (body, table of contents, etc.) does NOT include literature cited. This means that your literature cited section does not need to count toward the 26-page limit.

<u>What most folks choose to do is this</u>: They cite ample amounts of high-quality literature because doing so helps convey that they prepared a scientifically rigorous

document. They also designate their Literature Cited section as Appendix 1 because this tactic allows them to provide 3 or 4 pages of references, and yet those pages will not count against the 26-page limit because *there is no page limit for appendix material*.

5. **Be prepared to support everything in your prescription document**. If you include a stand exam printout, can you answer questions about the sample design used for the inventory? Which type of examination level was used (quick plots, extensive, etc.) and why? 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 as much about trees per acre – it's almost impossible to take enough plots to get good stats for TPA.]

   The point here is this: if you include a stand exam report as an appendix in your document, then the panel will assume it influenced 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 should 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 a NEPA process. This means an exam might have been completed before they selected a stand for certification, in which case they were probably not involved with developing the sample design or collecting field measurements.

   A bottom-line is: a candidate must be prepared to handle detailed questions about an exam used for certification purposes – responding to a query by stating, "That's a good question, but I didn't do the exam," is not an acceptable response.

   [Generally, most candidates either complete a stand exam themselves, or are fully 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 a stand's full spatial extent.]

   Tip: not everyone includes a stand-exam report in their document; if you're not completely comfortable responding to questions about an exam, then consider including a summary table containing key items from the exam (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.

6. **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 a dilemma – how 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. Even if it's clear they're wrong, treating them with disrespect will not be helpful to either of you.

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 a panelist is incorrect. If it turns out they are right, and you are actually wrong, or if a panel reaches consensus that a 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: In response to what seems like incorrect information, ask a clarifying question. This tactic can help ensure you don't misinterpret a panelist's statement – it's best to avoid a situation where you accuse a panelist of stating incorrect information, only to learn that you misheard what they actually said (or meant).

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, it may seem as though incorrect material is part-and-parcel of a question, but in many instances, a question can be answered reasonably while ignoring 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 a panelist becomes defensive or feels attacked or threatened, is almost never productive, regardless of who is 'right' or 'wrong.'

Using your response to gently point out an inconsistency or incorrectness, and not belaboring it by quickly moving onto the rest of your response, is always the best course of action. Try, at all costs, to avoid arguments or other situations where 'winners' and 'losers' are identified.

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 a situation you find yourself in (discretion), and then use these insights to avoid doing something you'll regret in the future (valor)).

7. **Carefully complete growth-and-yield modeling for your prescription**. I can't remember the last time this step was accomplished by using any option 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 default FVS 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 ever been observed on your home unit. As you might expect, a result like this is certain to generate a 'rich and full' discussion during a 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 (such as grand fir/elk sedge or grand fir/pinegrass), but default maximum SDI values are based on a late-seral, shade-tolerant species (generally a climax tree species such as grand fir).

What can happen is this: 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 a stand seems to add basal area and volume forever.]

Trip-Up: Same basic message as for the stand exam printout (item #5) – if you can't support FVS modeling results, then consider how much FVS output to include in your document.

But, also be aware that growth and yield prediction is central to the certification 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 default maximum SDI values in order to ensure that density-dependent tree mortality (self-thinning) is modeled correctly.

Trip-Up: Not adjusting maximum SDI values is an excellent way to produce an FVS printout 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, especially in a silviculture certification context.

Tip: If you begin to suspect that an FVS 'black box' is providing you with screwy results, and if you haven't worked on your home 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 adequately reflect local conditions.

If you bring your FVS printout to a sale administrator who's worked on the District for 30 years, and he or she looks at the volume per acre figures and laughs, then you might want to reevaluate your simulation parameters!

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 #5) and FVS results.

Note: in practice, you'd probably use FVS and its Fire and Fuels Extension to simulate snag production (e.g., standing dead trees) through time, and then compare resulting snag outputs against snag-level recommendations from 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 DecAID results, and their interpretations, in a short specialist report, which you can then cite.

Note: It is common practice to ask specialists from several different disciplines to prepare short reports specifically for your certification stand. This is often done for soils, visuals/aesthetics (if appropriate and needed), and insects and diseases. There is nothing that prevents you from doing the same thing for wildlife, hydrology, or anything else that might benefit from a little extra specialist support.

8. **You must have clear and unambiguous management direction**. This item and the next one (#9) deal with management direction and its influence on prescription development. In many respects, 'management direction' is a kingpin of your process – management direction provides goals, objectives, and evaluation criteria, and these three items are of utmost importance when crafting a certification prescription.

   Often, the NEPA process may not have been completed for a large planning area containing your stand. In this instance, you will need to find another source for management direction because it obviously 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 objectives are specific and preferably measurable; broad 'motherhood and apple pie' statements about keeping a forest green and growing might sound nice for a public field trip, but they certainly won't provide enough detail to meet your certification needs.

   Tip: You might want to help the Ranger prepare a 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.

   If your stand occurs in a large planning area for which NEPA is well advanced, but not yet complete, it is likely that much of your management direction can come from a draft document. Refer to a draft EA or EIS when helping the Ranger draft your management direction letter.

Trip-Up: Using nothing but management direction from your Forest Plan can unfortunately be problematic. For Blue Mountains national forests, and for many other Forests in Region 6 as well, Forest Plans are almost 30 years old now. Even their amendments (Eastside Screens, PACFISH, etc.) are decades old.

This means that best available science underlying these old Plans and their amendments may be as much as 40 years old, and much science of that vintage has now been supplanted or clarified with newer science.

When working with 'ancient' management direction, it may not be possible to take all Forest Plan standards and guidelines at 'face value.' Surprisingly little of a Forest Plan has a binary, black-or-white, either-or context; much of its management direction is gray and allows consideration of more than two alternatives.

This is a good thing because the Plans' advanced age has forced interpretation of their management direction to evolve quite a bit through time. A District Ranger letter provides you with contemporary management direction (interpretation), but it is also assumed to comply fully with your 1990 Forest Plan.

9. **Consider carefully how to evaluate alternatives**. A continuing panel issue involves evaluation of alternatives and processes used to weight or prioritize them. Generally, what happens is this: detailed goals and objectives are hopefully available for your certification stand (presumably provided by a District Ranger direction letter; see item #8 and appendix 3), they are used as a basis for developing evaluation criteria, and evaluation criteria are then scored in such a way as to help identify a recommended alternative.

   [Note: just like in NEPA, a silviculturist does not select a preferred alternative; you recommend a preferred alternative to a decision maker, who will hopefully follow your recommendation and then select it. But at the risk of being too nit-picky here, you will identify a *recommended* alternative, but not a *preferred* alternative.]

   Often, what happens is this: a long laundry list of evaluation criteria is developed (sometimes reaching 10 or 12 items, which is probably too many, 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 try to balance two competing tensions – include enough goals, objectives, and evaluation criteria (these three items are related – see appendixes 1 and 2 by Jim Long and others) 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 a reader to understand what is truly important (readers rightfully assume that your prescription is designed to address the most important stuff).

Criteria scores may be quantitative (numerical) or qualitative (yes/no, or high/moderate/low). One issue with a 'scoring' approach is that a long list of criteria frequently results in two or more alternatives with 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 a preferred alternative was identified because there may not be much separation between total scores, particularly if evaluation criteria are not prioritized (weighted) in some way.

Tip: Use your line officer (Ranger, etc.) to help you prioritize 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 advantage as rationale for recommending the alternative with a score of 29! But if criteria are prioritized, and if 4 of them are more important than the other 6, it is less likely that all three alternatives will end up in a tight group, particularly if *important criteria have a higher weighting factor*.

Tip: If you believe you have too many evaluation criteria, which may be hiding what's most important for your analysis, then scan the criteria scores to see if some do not vary much across alternatives. If you're using numerical scores (3 for high, 2 for moderate, and 1 for low, for example), and if you notice that several criteria have the same score for all three of your alternatives, then obviously these criteria are not influencing the outcome! You may decide to keep them to demonstrate you considered wildlife (or another resource value), even though wildlife scores don't change from one alternative to another, but it might actually be better to drop this 'clutter' because doing so could add additional 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 a second filter prioritizes criteria to help separate an alternative from the pack.

[Note: if weighting factors are used, a second filter is unnecessary because weights provide the same function – they serve to prioritize evaluation criteria.]

Tip: Set up your evaluation criteria to assist with your analysis. Using too many criteria, or scoring them so you end up with total scores very close to each other, forces you to bring in other considerations when identifying a preferred alternative.

To a certain extent, I view this outcome as a 'warning sign' – on one hand, you don't want to base your selection of a recommended alternative exclusively on scoring results, but on the other hand, if scores are too close to clearly identify an initial winner, the analysis process has not served you well – it basically forced you to set

aside evaluation criteria (which you worked hard to develop) and use other considerations when identifying a recommended alternative.

Tip: Two Field Notes from the Western Journal of Applied Forestry are included as appendixes 1 and 2 of this white paper – they offer helpful guidance about silvicultural alternatives and how to evaluate them.

Although both papers (appendixes 1 and 2) were prepared with a certified silviculturist in mind, I believe they relate more to alternatives in the NEPA process, and not as much with alternatives for the certification process. Even so, I strongly recommend they be reviewed by anyone preparing a certification prescription.

10. **Be careful in your use of silviculture terminology**. For example, will you be clear in your document about the difference between silvicultural systems and cutting methods? According to long-standing national direction, we have three silvicultural systems only: even-aged management, two-age management, and uneven-aged management. Each system 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 a clearcutting silvicultural system (instead of a 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 often include two silviculturists – one serving as panel chair and another as 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: Forest Service used to maintain its own version of silviculture terminology (in either the Manual or Handbook systems). This is no longer universally true because USFS adopted a source used by forestry as a whole – FS terminology is now largely based on a 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.

    [SAF's Dictionary of Forestry book was recently revised, and a new version was issued in 2017. Unfortunately, I cannot locate an online, searchable version of the Dictionary resource – although online order forms to purchase a copy of the new book are plentiful.]

    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 FACTS User Guide.

I also prepared a white paper, "Silvicultural Activities: Description and Terminology," providing definitions and line drawings for common silvicultural systems and cutting methods (Powell 2018).

Philosophical Point: I personally don't believe proper use of silvicultural terminology to be much ado about nothing (to quote Shakespeare) because one hallmark of a journey-level silviculturist 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?

11. Get prepared for your Regional panel experience.

By the time your Regional panel date rolls around, you have completed many steps along a road leading to silviculture certification. And, you checked and rechecked to be sure all requirements have been met (see appendix 4).

At this point in the process, you hopefully have been working with a cadre of advisors for quite a long while. They reviewed your prescription document and presentation many times, providing suggested updates at each step of your journey.

You successfully completed a Forest panel. Forest panelists provided you with a rigorous panel experience and appropriately replicated what you can expect from a Regional panel. The Forest panel recommended you request a Regional panel, and they recommended that your Supervisor's Office schedule a Regional panel for you.

[Important Note: Some folks believe, erroneously, that a Forest panel is powerless, and that completing a Forest panel is just "another step in the process." In my career, however, I once served on a Forest panel where a candidate was so ill-prepared that the panel refused to recommend they continue on to a Regional panel, and the panel chair directed the Forest to cancel the candidate's Regional panel, which had already been scheduled. *A Forest panel has full authority to take this action, and it is viewed as one of their roles and responsibilities*. This action by the Forest panel didn't mean that the person was 'through' with certification, but it did put their whole process back by a full year.]

And so, with all that has gone on before, you are now well prepared for your Regional panel. But, after you prepare your final prescription 'packages' and mail them to the Regional Office, you have four to six weeks of final preparation time before heading to your Regional panel defense. This period is a good time to brush up on final preparations.

Tip: If you haven't done so already, become thoroughly familiar with a Regional Handbook supplement relating to silviculture certification (R6 Handbook Supplement describing certification prescription standards, R6 Supp. 2409.17-2011-2 to

FSH 2409.17, dated Aug. 29, 2011). It's likely you've been using this Handbook Supplement throughout your process, in which case this tip is encouraging you to review it again, one last time, as a refresher.

Tip: When reviewing the R6 Handbook Supplement, pay close attention to sections like 8.76, which describes panel members roles. Section 8.76 describes the makeup of your panel; reviewing it helps you anticipate the type and breadth of questioning you'll need to be prepared for.

Tip: Section 8.81 of the R6 Handbook Supplement provides "Tips for Certification Defense." As you might imagine, this is a good section to review as you get prepared for your Regional panel. Although there is some overlap between them, section 8.83 of the Supplement, *Suggestions for Improvement from Previous Candidates*, is good to use in tandem with section 8.81 during Regional panel preparations.

Tip: Here comes the most important tip in this section: spend ample time with section 8.82 of the R6 Handbook Supplement – "Examples of Questions that are Frequently Asked During Certification Exams." Section 8.82 provides 50 questions that have been asked during a certification panel. Although 50 questions sounds like quite a few, they cover the whole Region, and some won't pertain to your stand. When I was Forest Silviculturist for Umatilla NF, we often supplemented this section with other questions developed locally.

Appendix 5 of this white paper provides the Region's questions from section 8.82, plus a few supplemental questions reflecting recent panel queries.

Another process has also worked well regarding the questions in appendix 5: advisors or mentors would email a question or two to a candidate in the morning, and then the two of them would discuss the candidate's response later that day. This approach may be a better fit for busy schedules, since it can be difficult to block out a big chunk of time to review all the questions at once.

Tip: Build yourself a 3-ring binder of 'hip-pocket' information to bring with you to Portland (or wherever your Regional panel will be convened). Even though you provide the panel with lots of supplemental information as appendix material, you'll want to bring other background information with you.

Don't forget – you can bring these materials (such as a 3-ring binder) into the panel room with you, and don't be afraid to use them in response to a question. In the heat of the moment, it is always tempting to respond to a question quickly and decisively (thereby showing the panel you are well prepared and know your material inside out), but sometimes it is better to look something up before providing an answer. You won't be 'penalized' in any way for referring to a document or consulting your binder before providing an answer.

If your stand is included in a completed CE, EA, or EIS, then bring that documentation along. You may want to copy pages from your Forest Plan pertaining to the management allocation for your stand. If your stand is influenced by the Eastside Screens amendment, then bring a copy of the Screens document along.

What other 'hip-pocket' information should you consider bringing with you? Include background items not included as appendix material. Anticipate what types of questions you might receive and bring information that might help you respond to them. And, include any information in the binder that you'll want to review during the night before your panel, or bring it along in a separate folder.

Trip-up: Bringing a large binder, or several binders, and then fumbling around with them in response to a question will not convey that you are well prepared. One way to guard against this is to try and avoid the 'kitchen sink' approach as much as possible – although it may be hard to do, try to find a 'sweet spot' where you bring a reasonable amount of background material, and you have it well tabbed and organized in either a binder or expandable folder, and leave the extraneous stuff behind.

What may happen is that uber-prepared folks try to anticipate 'ringer' questions, and then bring material to respond to them. After years of preparation and work to get to a Regional panel (counting NASP), it can be hard to resist this temptation. But my experience is: Don't focus on ringer questions! (See my thoughts on this subject in *Appendix 5: Example Panel Questions*.) If the panel process is run correctly, a panel chair will try to keep the panel focused on your stand, and its context, and limit the number of questions coming in from left field.

12. **Finally, here is a perspective from someone who successfully 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."

These excellent and helpful insights convey that 'getting certified' is most assuredly your short-term objective, *but a secret to a successful career as a silviculturist (after all, isn't this your long-range goal?) is to become a life-long learner*.

REFERENCES

Helms, J.A. 1998. The dictionary of forestry. Bethesda, MD: Society of American Foresters. 210 p. isbn:0-939970-73-2

Long, J.N.; Kurtzman, J.A. 2012. What makes a range of silvicultural alternatives reasonable? Western Journal of Applied Forestry. 27(4): 212-214. doi:10.5849/wjaf.11-008

Long, J.N.; Smith, F.W.; Roberts, S.D. 2010. Developing and comparing silvicultural alternatives: Goals, objectives, and evaluation criteria. Western Journal of Applied Forestry. 25(2): 96-98. doi:10.1093/wjaf/25.2.96

Powell, D.C. 2018. Silvicultural activities: Descriptions and terminology. White Pap. F14-SO-WP-Silv-34. Pendleton, OR: USDA Forest Service, Pacific Northwest Region, Umatilla National Forest. 34 p. https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5413732.pdf

Watrud, E.; Zensen, F.; Darbyshire, R. 2012. Laws affecting reforestation on USDA Forest Service lands. Tree Planters' Notes. 55(2): 39-42. laws-affecting-reforestation-on-usda-forest-service-lands

APPENDICES

Appendix 1: *Developing and Comparing Silvicultural Alternatives: Goals, Objectives, and Evaluation Criteria* by Dr. Jim Long and others (2010; WJAF, volume 25, issue 2).

Appendix 2: *What Makes a Range of Silvicultural Alternatives Reasonable?* by Long and Kurtzman (2012; WJAF, volume 27, issue 4).

Appendix 3: Example of a Management Direction Letter

Appendix 4: How to Review a Certification Prescription (R6 Version)

Appendix 5: Example Panel Questions

Appendix 6: Silviculture White Papers

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.

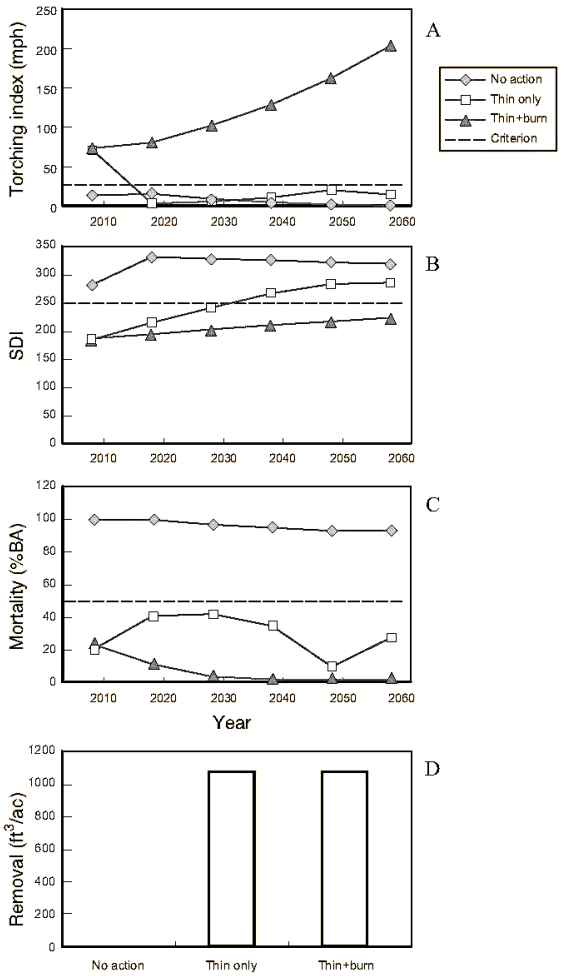

Figure 1. Comparison of three alternatives with respect to evaluation criteria: (A) torching index >27 mph; (B) stand density index (SDI) < 250; (C) mortality <50% of stand basal area (%BA); (D) removals >1,000 ft^3/ac.

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.

Literature Cited

DIXON, G.E., COMP. 2002 (last revised January 29, 2009). *Essential FVS: A user's guide to the Forest Vegetation Simulator*. Internal Report. US For. Serv., For. Manag. Serv. Ctr., Fort Collins, CO. 219 p.

GULDIN, J.M., AND GRAHAM, R.T. 2007. Silviculture for the 21st century—Objective and subjective standards to guide successful practice. P. 109–120 in *Restoring fire-adapted ecosystems: Proceedings of the 2005 national silviculture workshop*, Powers, R.F. (tech. ed.). US For. Serv. Gen. Tech. Rep. PSW-GTR-203. 306 p.

LONG, J.N., AND SHAW, J.D. 2005. A density management diagram for even-aged ponderosa pine stands. *West. J. Appl. For.* 20:205–215.

OLIVER, W.W. 1995. Is self-thinning in ponderosa pine ruled by *Dendrotonus* bark beetles? P. 213–218 in *Forest health through silviculture. Proc. of 1995 National Silviculture Workshop, May 8–11, 1995, Mescalero, NM*, Eskew, L.G. (comp.). US For. Serv. Gen. Tech. Rep. RM-267. 246 p.

REMPEL, R.S., ANDISON, D.W., AND HANNON, S.J. 2004. Guiding principles for developing an indicator and monitoring framework. *For. Chron.* 80:82–90.

STEPHENS, S.L., MOGHADDAS, J.J., EDMINSTER, C., FIEDLER, C.E., HAASE, S., HARRINGTON, M., KEELEY, J.E., KNAPP, E.E., MCIVER, J.D., METLEN, K., SKINNER, C.N., AND YOUNGBLOOD, A. 2009. Fire treatment effects on vegetation structure, fuels, and potential fire severity in western U.S. forests. *Ecol. Applic.* 19:305–320.

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.

Literature Cited

CEQ. 1978. *NEPA: Implementing regulations* (40 CFR Parts 1500–1508).

CZARNEZKI, J.J. 2003. Defining the project purpose under NEPA: Promoting consideration of viable EIS alternatives. *U. Chicago Law Rev.* 70(2):599–619.

FREEMAN, L. 2009. Range of reasonable alternatives. *Shipley News*, Vol. 69. Available online at www.shipleygroup.com/news/0911.html; last accessed July 19, 2011.

FREEMAN, L. 2010. Objectives and NEPA's purpose and need. *Shipley News*, Vol. 76. Available online at www.shipleygroup.com/news/1010.html; last accessed July 19, 2011.

HABITAT EDUCATION CENTER, INC., V. U.S. FOREST SERVICE. 2009. 593 F. Supp. 2d 1019 (E.D. Wisc. 2009).

LONG, J.N., F.W. SMITH, AND S.D. ROBERTS. 2010. Developing and comparing silvicultural alternatives: Goals, objectives and evaluation criteria: A technical note. *West. J. Appl. For.* 25:96–98.

SIMMONS V. UNITED STATES ARMY CORPS OF ENGINEERS. 1997. 120 F3d 664, 668–69 (7th Cir 1997).

SMITH, M. 2007. A review of recent NEPA alternative analysis case law. *Environ. Impact Assess.* 27:126–144.

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, 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: HOW TO REVIEW A CERTIFICATION PRESCRIPTION

R6 version – Contributed by Robyn Darbyshire, Regional Silviculturist

1. Page limits and page margins – Were they met?
2. Are sources included in a Literature Cited section actually cited in the document? If not, remove them.
3. Is literature cited in the document included in a Literature Cited section?
4. Does appendix material only provide information supporting the main body of a prescription? If not, remove it.
5. Is all information in the main body of a prescription document relevant to the stand prescription? If not, remove it.
6. Can the main body of a prescription stand on its own without any material in an appendix?
7. Do all alternatives comply with LRMP standards and guidelines? Do they comply with other planning guidance (i.e., critical habitat)? NFMA? All FS policy?
   If not, have appropriate steps been followed for exceptions (i.e., project-specific Plan amendment, public notice, etc.)?
8. Is proper silvicultural terminology used? Look it up.
9. Implementation and Monitoring Plan – only done for recommended alternative (the prescription is not a NEPA document).
10. Are all costs and revenues included in an economic analysis?
11. Are figures legible? Are axes labelled? Is there a sentence describing each figure and table in the main text? Do maps and charts have a legend?
12. Define all acronyms (including those used in tables and figures).
13. Make sure all your objectives have measurable metrics – not 'high quality' or 'looks good.'
14. Are all objectives accounted for in your decision matrix?
15. Each metric in a decision matrix should match a metric from an objective.
16. If you don't need something for the prescription, and it is not needed for a final decision, then remove it.
17. How does your stand tie into the rest of its landscape? Is it similar to other stands, or does it meet a critical need?

APPENDIX 5: EXAMPLE PANEL QUESTIONS

Listed below are some example questions from Region 6 silviculture certification panels. They are similar to questions provided in section 8.82 – Examples of Questions That Are Frequently Asked During Certification Exams – of an R6/PNW Supplement to FSH 2409.17, Silvicultural Practices Handbook. Sometimes, I edited a question for brevity or clarity, or I added personal perspectives as background context.

Many of these questions are somewhat general. When preparing for your panel defense, *you should expect that most questions will be specific to your stand and your prescription document*. In fact, that's the reason this appendix is not labeled 'Frequently Asked Questions' – some of the questions below are general, and general questions are not as frequently asked during a panel as those dealing specifically with your stand.

[Many of the questions below are relatively specific, however, and I believe they well represent the type of questions you should be prepared to handle.]

Non-specific questions in a 'general knowledge' realm, however, are certainly 'fair game' in a certification context. General-knowledge questions assess how well your education (both from NASP and before) and experience has prepared you to be a fully functional silviculture practitioner.

When I had the pleasure of serving as a panel chair, I would brief the panel before a candidate was welcomed and the panel process began. During the briefing, I cautioned panelists to refrain from asking general-knowledge questions.

During the interview portion of a certification panel, time constraints allow each panelist to ask between three and five questions. Why should a panelist waste their precious questioning time by asking a general-knowledge question? Experience has consistently shown that interview time is best used to examine a candidate's specific stand and prescription document.

Another reason I tried to discourage general-knowledge questions is that they can seem like off-the-wall, odd-ball queries, especially if they come late in an interview period when other questioning has been specific to a stand and prescription. I have seen instances where a panel was going well until a 'ringer' question was asked, which is not only disconcerting to a candidate, but can also be disruptive to panel flow and mood.

A bottom-line: No candidate has unlimited amounts of preparation time, and I believe yours is best spent preparing for specific questions about your stand and its prescription. I believe you have little to gain by using valuable prep time for general-knowledge questions.

[An example of spending your prep time wisely: I see little to be gained from hauling out your old forestry textbooks and spending hours going through them as preparation for general-knowledge questions.]

If you do have sufficient time when preparing for your panel, however, then quickly review the list of questions below to get a feel for the types of general-knowledge topics that might be touched on.

1. What are differences between even-aged and uneven-aged management? What does a stand growth curve look like for each system?

2. I noticed your range of alternatives excluded group selection (or some other cutting method). Explain how you developed your alternatives, which resource areas were represented on the ID team, and who selected the final alternative.
   [Note: When answering a question like this, it is generally a good idea to emphasize the point that a silviculturist does not 'select' the final alternative because a silviculturist is not a line officer. As a silviculturist, you recommend a preferred alternative, but a line officer – usually the District Ranger or Forest Supervisor – makes final decisions about which stands will be treated and the treatments to be applied (they make this decision when they sign a DN or ROD). This is the reason that a silvicultural prescription is not prepared until the project design stage – when a selected alternative has been identified in an environmental document (CE, EA, or EIS), and a silviculturist then knows which silvicultural treatment is to be implemented for each stand to be entered.]

3. I understand your preferred alternative, but explain how the preferred alternative relates to the surrounding area. In other words, what is the relationship between how you treat your stand and surrounding stands? What about landscape management and visuals for your stand?

4. Describe the plant associations (plant communities, habitat types) listed in your prescription. You use the terms seral, climax, reproducing successfully, and constancy. Please discuss how you used these terms, and how they relate to your plant association and stand.

5. On page 7 of your document, you state that your stand has a dense undergrowth of mules-ear plants. Would this outcome be expected for your stand's plant association? What do you think the dense stand of mules-ear indicates? Would you expect any inhibitory effects from mules-ear on natural or planted tree regeneration?

6. You state that your stand is beginning to experience invasion from western juniper. Would this trend be expected for your stand's plant association? What does this compositional trend indicate in terms of disturbance ecology? What threshold value would you suggest as a measure of 'too much' juniper invasion?

7. Explain the geology of your stand and how it relates to soil types, fertility, tree rooting depth, and overall tree growth.

8. Since compaction and displacement of the soil is a major issue for your stand, what measures are you using to prevent soil compaction and displacement? What are unacceptable soil conditions for your stand? List them for me.

9. I see that your stand is on the eastside of Region 6. Please explain the term 'Eastside Screens.' How did the Screens affect your alternatives and final silvicultural prescription?

10. Please elaborate: If you had NOT assumed a 21-inch DBH limit for prescription development, as required by Eastside Screens, how might your preferred alternative have differed with respect to its commercial viability at the end of your 100-year planning horizon (rotation)?

11. On page 19 of your prescription document, you state that ponderosa pines would begin growing beyond the 21" dbh limit at age 90. And, on that same page, you state that a shelterwood seed cut would be prescribed then to capture some of the ponderosa pine volume before it moved into the 21"+ diameter range. Would you have scheduled the shelterwood seed cut differently had the 21" limit not been a consideration? If so, how and why?

12. I see that your stand is on the westside of Region 6. How does your stand fit into the Northwest Forest Plan (NFP)? How did the NFP amend your Forest's 'Land and Resource Management Plan?' How do NFP amendments affect your stand, and what additional constraints did they impose on your silvicultural prescription?

13. Due to Northwest Forest Plan requirements, your prescription emphasizes maintenance of a multi-layered structure. You expect this structure to promote western hemlock through time. Does your prescription include any activities specifically designed to help Douglas-fir persist in a multi-layered structure and, if so, what are they?

14. Please give me a discussion about coarse woody debris and how it relates to your stand. Will you be able to provide adequate habitat for snag- and wood-dependent wildlife throughout the course of your prescription? Why or why not?

15. I note that you have an objective to provide future snag habitat as GTRs (green tree replacements), and that you intend to leave large, living trees as this habitat component. Which bark-beetle species would you expect to have the most influence on your desired GTR leave trees, and why?

16. Your stand exam reports statistics such as standard deviation, standard error, confidence intervals, etc. Please explain how you interpreted this statistical inventory information for your stand. What do these measures mean?
    [Note: Sometimes, a panel will include a member who is keyed into statistics. If your panel fits this bill, then you may expect questions about standard errors and similar statistical measures, and whether the stats for your specific stand exam (often included as an appendix in the certification prescription document) indicate that you used a sufficient number of sample plots for your exam.]

17. Explain how you developed the economic analysis for your stand. Explain differences between present net worth and present net value.

18. What is meant by bare land value? Did this concept have any bearing on your prescription development?

19. You have existing timber on your stand. How was its value used during an economic analysis for your stand?

20. Why didn't you do a sensitivity analysis using a higher or lower interest rate? Why did you use 4% (or some other percentage) as your selected interest rate? How does raising or lowering the interest rate affect your project's viability?

21. You state that an entry for year 80 would be noncommercial because not enough timber volume would be available to support a commercial entry. How much volume per acre must be present for a commercial entry, and why was your stand unable to produce enough volume to reach that level?

22. What if something goes wrong during implementation? Did you develop a contingency plan? If so, which activities or outcomes did you develop contingencies for, and why?
    [Note: This contingency item needs to be handled carefully due to prescription page limits. On the one hand, writing a prescription as though everything will go perfectly, as if contingencies don't need to be considered, is not realistic. On the other hand, trying to include contingency measures for everything in your prescription is not generally possible due to page limitations. At a minimum, I suggest you include contingencies for reforestation treatments because not doing so will typically be questioned.]

23. You talk about stand density index in your prescription and use it to describe a relative density condition. Please explain why you selected stand density index as a relative density measure for your stand/prescription.

24. When reviewing the stand exam results in appendix 5, I see that grand fir has only 1% of your stand's basal area but 35% of its trees-per-acre (tpa) stocking. What does this result mean, and what size class would we expect the grand fir trees to be

in? Conversely, if a species has 35% of a stand's basal area but only 1% of its tpa, what is the predominant size class for the species?

25. On page 19, you state that individual tree growth is much less than potential for that type of site. How did you determine this? Was it based on stand exam results, and if so, which ones? Did you sample individual trees to make this determination and, if so, how was the sampling completed (bore trees, etc.)? Was individual tree growth assessed by using radial growth in 20ths of an inch and, if so, why?

26. Your stand exam results show that your stand has an average crown ratio of 58%. What does this mean? Would you associate an average crown ratio of 58% with an overall stand vigor level of low, moderate, or high, and why?

27. How did you model the stand? Please describe your modeling framework and process.

28. Why did you choose the growth and yield modeling system, and its associated extensions, that you used instead of another modeling alternative?

29. Describe how the modeling system you used projects the growth of your stand. Do you believe it did an adequate job of projecting stand growth through time? Why or why not?

30. How does your model deal with mortality? Describe whether, and how, you calibrated the model's mortality functions to better fit your specific conditions.

31. When reviewing your appendix providing FVS keywords used during the modeling process, I see that you used Fixmort keywords to direct tree mortality as based on SDI levels. Why did you decide to use Fixmort to account for density-related tree mortality instead of using parameters associated with the SDIMAX keyword?

32. How did you calibrate components of your growth and yield modeling system other than mortality? Did you calibrate the model for diameter or height growth and, if so, how was that done?

33. You have several species in your stand, but the growth and yield modeling system you used is geared toward Douglas-fir. How did you handle this issue when simulating growth and development of your mixed-species stand?

34. What are the advantages and disadvantages of the growth and yield modeling system you used to project your stand?

35. Climate change modeling suggests that conditions in the general area of your stand could be much dryer and warmer by the year 2060. Did you adjust your modeling in any way to account for a warmer and dryer future and, if so, how was this done?

36. What did you use for a stocking level curve? How did you decide when to schedule a precommercial or commercial thin?

37. Why now? Current stand condition suggests that several of your evaluation criteria are very close to meeting your DFC (desired future conditions) right now. Why did you prescribe an entry now, rather than waiting another 10 or 20 years?

38. You used Curtis's relative density with your stand. Explain how you used it in your stand, and please describe what a relative density of 40 means.

39. How did you determine when the first commercial entry would be for your stand, and which factors were used to help make that decision?

40. I see that you use a 30-year treatment cycle – there is 30 years between each thinning or burning treatment. How did you settle on 30 years as an optimum cycle, and which factors were considered when making that decision?

41. I notice you didn't describe any archaeological sites in your prescription. Did you have a cultural resource survey completed for your stand?

42. How did you handle riparian areas and wetlands in your stand? What does the term aquatic conservation strategy mean to you?

43. Which stream condition classes exist in your stand? Describe what they are, and how they influenced development of your certification prescription.

44. Explain how your prescription protects the downstream fishery resource. During your introductory presentation, you mentioned the word PACFISH. Explain what this term means, and how PACFISH affected development of your prescription.

45. When consulting historical aerial photographs in your appendix 9, I see that a stock-watering pond was apparently constructed in the early 1970s. If the pond is used primarily for watering livestock, do you believe it is appropriate to apply PACFISH buffers around the pond and, if so, why?

46. You state that existing road density for the subwatershed containing your stand is 4.3 miles per square mile, and that this high density has altered hydrological function of the watershed. Please explain some ways that hydrological function has been altered. How might you account for this altered function in your prescription?

47. Describe what the ecosystem management concept means to you. Did you apply ecosystem management concepts when preparing your prescription and, if so, how and why?

48. I see you are prescribing a new treatment concept by using 'skips and gaps' in conjunction with variable-density thinning. Will skip and gap areas designated during

the first entry in 2020 remain static (as a skip or gap) throughout the entire 100-year planning horizon? Why or why not?

49. Your marking guide shows that 10 to 15 percent of the stand will remain untreated as 'skip' areas. Will skips be exposed to prescribed fire like the rest of the stand and, if so, will they be protected from fire in any way? If skips will be exposed to on-going use of fire, what fire effects do you anticipate for them through time?

50. Your prescription involving skips and gaps specifies that 30% of the stand will be retained as untreated skips and that 10% will be in gaps. What was your basis for choosing 30% and 10% instead of other values?

51. Describe the fire history of your stand. How did fire history affect your stand's development over time?

52. On page 12 of your prescription document, you state that a spring prescribed burn is preferred. Why is spring preferred, and is use of prescribed fire in spring compatible with your stand's fire history and its fire regime?

53. I see that much of the landscape surrounding your stand is assigned to a different fire regime than it. Would you expect this landscape context to result in a fire return interval for your stand that is more or less frequent than would otherwise have been expected? Why or why not?

54. In your prescription document, you state that the predominant disturbance agent affecting Blue Mountains landscapes was fire, and that you intend to mimic fire by how you prescribe free selection as a cutting method. If you had assumed that mountain pine beetle or western spruce budworm was the predominant disturbance agent influencing your stand, instead of fire, would this decision have affected the prescription and, if so, how and why?

55. Your development of alternatives did not seem to be closely tied to management direction and desired future conditions. Was some management direction overlooked or intentionally ignored?

56. Describe your desired future conditions and how they relate to overall management direction. How were your desired future conditions used when developing silvicultural alternatives?

57. I see that your desired future condition uses an age limit of 150 years to define old forest. Why do you believe that an age limit is a better option than a diameter limit (21 inches) for defining an old-forest condition?

58. I noticed that your Forest uses 40% of maximum potential biological capability as a wildlife habitat measure. Please describe what it means to have a 40% level for biological potential, and please define biological potential. Is biological potential equivalent to biological capability?

59. Describe the elk habitat effectiveness index (HEI) used on your Forest as a wildlife habitat measure, and explain what HEI means. What do hiding cover and thermal cover mean, and did either one of them influence your stand's prescription?

60. Your Forest is in a spotted owl habitat area. Describe how historical timber-cutting practices on your Forest affected owl habitat. What do the 'forest fragmentation' and 'late successional reserve' terms relate to? Did these concepts have a bearing on how you developed a certification prescription for your stand?

61. Are any threatened or endangered species present in or near your stand? If so, how did you provide for their protection?

62. You described the presence of certain insects or diseases in your stand. Please explain the life cycle of these organisms, and how you plan to account for future outbreaks.

63. You have dwarf mistletoe in your stand. What is the six-class mistletoe rating system, and was it used as a monitoring or inventory tool for your stand?

64. A major concern for your stand is Douglas-fir dwarf mistletoe. The Eastside Screens prevent you from removing large-diameter Douglas-firs with high mistletoe levels. Did you examine the effect of retaining all large Doug-firs on future mistletoe levels? If future mistletoe levels were severe, which mitigation measures could you have considered to compensate for the Screens requirement?

65. I see that you use a 3-factor system to rate stand susceptibility to Douglas-fir beetle. One of the three factors is tree size. Because the Eastside Screens prevent you from removing large trees, would you want to adjust the other two factors to compensate for this restriction and, if so, how?

66. Animal damage appears to be rampant in your stand. Describe the primary factors influencing animal damage for most forested environments.

67. Since animal damage is apparently a problem for your stand, which prevention measures do you plan to take to limit future animal damage issues?

68. You talked about pocket gophers in your stand. How can knowing the gopher life cycle help you prevent future damage from gophers?

69. I notice that you prescribe planting with genetically improved stock. How much gain do you expect from using genetically improved stock, and why?

70. Please provide a detailed description of the reforestation plan for your stand. Why do you have such high reforestation costs? How could you modify your reforestation practices to mitigate some of the high costs?

71. You use the acronyms MAI, CMAI, and PAI in your prescription. Which terms do these abbreviations refer to? Discuss how these items were used in your prescription, and the interrelationships between them. Can we schedule a regeneration harvest at 95% of MAI? Why or why not?

72. You did not extend your stand through a complete rotation (i.e., existing stand plus future stand). Is this going to be a problem? Why or why not?
[Note: This question gets at a 'big deal' in the certification process. Refer to item # i in section 8.63 of the Region's 2409.17 Handbook Supplement (Aug. 2011) dealing with silviculture certification [Does the candidate outline in detail the steps necessary to manage the stand for a period of time sufficient to represent the growth of the current stand and the regeneration (due to harvest or natural disturbance) of the future stand?]. Not addressing this item is viewed as a 'fatal flaw' and would result in an outright failure at a panel, or in your prescription being returned before a panel even occurred. The issue is this: you need to bring your stand through an entire rotation, including final harvest or 'natural disturbance' sufficient to terminate your existing stand and initiate (regenerate) a new stand. It is often overlooked now because little regeneration cutting occurs on either the west or east sides of R-6, so folks are not used to thinking in terms of a full rotation or regeneration cutting to start a new stand. But, your certification prescription cannot include an intermediate treatment (commercial thinning, improvement cutting, etc.) and end there. You must plan to bring your stand to culmination of mean annual increment and then regenerate a new stand, either with timber harvest or a natural disturbance event (stand-replacing fire, for example).]

73. You developed a detailed management regime for your specific stand. How does your stand and its proposed regime mesh with management objectives for its broader landscape?

74. How are your proposed treatments expected to affect long-term fuel loading for your stand? How would fuel loading changes for your stand be expected to affect the landscape in which it occurs?
[Note: In this era, it is difficult for an eastside prescription to not include some level of fuels considerations. Even if your stand does not have an explicit fuels emphasis (WUI, etc.), you should expect any eastside R-6 prescription to generate fuels questions.]

75. I see that your stand has a Fire Regime Condition Class rating of 3. Which factors in the FRCC system were most influential in causing this outcome? Did veg-fuel classes depart substantially from their reference conditions, or was it based on a recent lack of fire?

76. If your stand occurs near wildland urban interface (WUI), how did you address this issue when developing your prescription and its proposed treatments?

77. Your management direction table on page 14 states that all prescribed burning will be done no sooner than 3 years vegetation treatment. What is the rationale for this requirement, and did it have any influence on your prescription development?

78. If you had no constraints from a Forest Plan or other management direction, what treatment regimen would you propose for your stand?

79. How would your preferred alternative change if "X" happened?
[Note: Recently, it has been common for panels to ask one or more 'scenario' questions. These questions may not have much direct bearing on your specific stand, but they are designed to assess how well you can extrapolate thought processes used for your prescription development to a different set of circumstances. May not be the easiest type of questions to prepare for, but they examine how well you can 'shift gears' when presented with changed conditions.]

80. Your alternative 2 is referred to as 'clumpy leave trees.' The phrase 'clumpy leave trees' refers to a stand condition or desired outcome. What is the silvicultural objective for this alternative – which goal or objective is clumpy leave trees trying to address?

81. You state that thinning will remove suppressed and intermediate trees down to a minimum diameter of 7 inches. You have a basal-area (BA) stocking objective of 40-60 square feet per acre. Does this mean that you will leave 40-60 sq.ft./acre of BA in trees between 7" and 21"? If not, then how much of the 40-60 BA target did you allocate to trees below 7", and why?

APPENDIX 6: 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. Ex-

amples include papers dealing with historical products: (a) historical fire extents for the Tucannon 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 Blue Mountains dry forests: Silvicultural considerations
5	Site productivity estimates for upland forest plant associations of Blue and Ochoco Mountains
6	Blue Mountains fire regimes
7	Active management of Blue Mountains moist forests: Silvicultural considerations
8	Keys for identifying forest series and plant associations of 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 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 Blue and Wallowa Mountains
21	Historical fires in headwaters portion of 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 Blue Mountains insects and diseases
26	Is this stand overstocked? An environmental education activity
27	Mechanized timber harvest: Some ecosystem management considerations
28	Common plants of south-central Blue Mountains (Malheur National Forest)
29	Potential natural vegetation of Umatilla National Forest

Paper #	Title
30	Potential vegetation mapping chronology
31	Probability of tree mortality as related to fire-caused crown scorch
32	Review of “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 Pomeroy and Walla Walla Ranger Districts
36	Stand density protocol for mid-scale assessments
37	Stand density thresholds 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 Blue Mountains variant of Forest Vegetation Simulator
40	Competing vegetation analysis for southern portion of Tower Fire area
41	Using General Land Office survey notes to characterize historical vegetation conditions for Umatilla National Forest
42	Life history traits for common Blue Mountains conifer trees
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	Knutson-Vandenberg (K-V) program
47	Active management of quaking aspen plant communities in northern Blue Mountains: Regeneration ecology and silvicultural considerations
48	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 Umatilla National Forest: A range of variation analysis
51	Restoration opportunities for upland forest environments of 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	State of vegetation databases for Malheur, Umatilla, and Wallowa-Whitman National Forests
58	Seral status for tree species of Blue and Ochoco Mountains

REVISION HISTORY

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

June 2019: formatting and text edits were made throughout; a cover page graphic showing a Certified Forest Service Silviculturist certificate and a table of contents section were added; and several new sections (Get prepared for your Regional panel experience, and appendix 5 relating to Example Panel Questions) were added.