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James Melonas
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cc:
Nicholas Larson, District Ranger, Grandfather Ranger District
Jennifer Barnhart, District Ranger, Appalachian Ranger District
David Casey, District Ranger, Pisgah Ranger District

Re: Substantive Comments on Grandfather, Appalachian, Pisgah (GAP) Restoration Project Draft Environmental Assessment

Dear Mr. Melonas,

Introduction

The GAP Restoration Project's focus on restoring fire-adapted ecosystems and reducing wildfire risk is commendable and necessary for the long-term health of the Pisgah National Forest. The emphasis on using prescribed fire as a management tool aligns with ecological best practices and historical fire regimes in these forest types. However, the inclusion of commercial timber harvest as a restoration technique is concerning and potentially counterproductive to the project's stated goals.

The GAP project's stated intention to increase the pace and scale of restoration activities presents a unique opportunity to prioritize the most effective and widely supported management tool: prescribed fire. Separating prescribed fire from commercial timber harvest in both planning and implementation would offer several significant advantages:

1. It would allow for a more rapid deployment of fire management across the landscape, as prescribed burning generally faces fewer regulatory hurdles and enjoys broader stakeholder support compared to commercial logging operations.

2. This approach would enable a clearer assessment of fire's impacts on forest structure and composition without the confounding effects of timber removal.

3. Prioritizing prescribed fire aligns more closely with the project's core objectives of restoring fire-adapted ecosystems and reducing wildfire risk.

Any consideration of mechanical vegetation treatments, particularly commercial timber harvest, should only occur after thorough analysis of the outcomes from prescribed fire treatments and further collaboration with the public and stakeholders. This sequenced approach would ensure that more invasive management techniques are only employed where absolutely necessary and with full transparency.

Prescribed Fire

While the GAP project correctly identifies prescribed fire as a key tool for ecosystem restoration and wildfire risk reduction, the environmental assessment falls short in providing crucial details about its application across diverse ecozones. The Pisgah National Forest encompasses a range of ecosystems with distinctly different historical fire regimes, from frequently burned pine-oak woodlands to mesic cove forests that rarely experienced fire. A one-size-fits-all approach to prescribed burning risks inappropriate application and potential ecological harm.

For instance, the fire return intervals and intensities suitable for restoring shortleaf pine-oak ecosystems, which historically experienced frequent low-intensity fires, would be entirely inappropriate for rich cove forests that evolved with infrequent disturbance. Similarly, the timing, frequency, and intensity of burns needed to maintain high-elevation red oak forests differ significantly from those required in dry oak or pine-oak heath communities.

More concerning is the use of fire in ecozones where species are not adapted to fire such as rich coves.

The environmental assessment's broad generalizations about the benefits of prescribed fire, despite consideration of ecozone-specific fire regimes, raise concerns about the ecological appropriateness and potential impacts of the proposed burning program. Since VMAs encompass many ecozones it isn't clear how fire can be applied specifically as needed per ecozone. This lack of nuance could lead to misapplication of fire, potentially causing unintended damage to fire-sensitive species or failing to achieve desired restoration outcomes in fire-adapted communities.

The Forest Service provided GIS data that details Areas of Interest (AOI) and delineated Vegetation Management Areas (VMA) where commercial or non-commercial ground-disturbing activities could occur. However, the AOIs cover up to thousands of acres each, and the VMAs, even though they are more granular, typically encompass many forest types (EV_Codes) and ecozones. It's difficult to analyze impacts when the areas where treatments are proposed are so distinctly different WITHIN themselves.

In section 2.1.1 Activity Locations, the EA attempts to 'wave away' concerns about appropriate use of fire per ecozone with the statement:

"Prescribed burning and vegetation management could occur, but would not be emphasized in mesic ecozones (i.e., acidic cove, rich cove, northern hardwoods, spruce fir, floodplain forests). Activities in mesic ecozones would generally be incidental to activities in neighboring dry or moderate ecozones. The inclusion of mesic ecozones in the Project Area is a practical condition of conducting landscape-scale restoration and enables wildfire risk reduction for communities. More information on effects to these non-target ecozones is in Chapter 3."

This is entirely inadequate for an Environmental Assessment.

Table 2, Prescribed Burn Return Intervals, notes ecozones and the average desired return interval. It is clear from the table that different ecozones have different return intervals - but AOIs and VMAs have been delineated across many different adjoining ecozones, making it difficult to assess how different return intervals could be managed. What is the point of the AOIs and VMAs if they cannot be used as a planning tool? There are multiple instances where adjoining VMAs all include multiple ecozones when the VMAs could have been better drawn to include only (or predominantly) ecozones with the same return intervals.

Commercial Logging and Ground Disturbing Treatments

The Vegetation Management Areas (653 in total) cover more than 25,500 acres. The Environmental Analysis attempts to describe the possible vegetation treatments used within these 25,500 acres using a toolbox analogy. This is problematic because the 'tools' are described quite generally, and the application of these tools, i.e., where they will be used and under what conditions or constraints, is not described at all. Despite delineating 'with a sawtimber product' and 'without a sawtimber product' areas, the Forest Service allows every tool to be used in either area and does not define what 'a sawtimber product' actually means.

In Section 2.1.2 Activity Types, the EA again attempts to hand-wave away significant lack of detail by considering that such detail would be impractical and can anyway be undertaken later:

"The GAP Project uses a toolbox approach that allows predetermined activities to be aligned with current conditions on the ground. Comprehensive information about the conditions found across every acre in the landscape is incomplete, but sufficient data is available to make informed decisions about needs for treatment, general activities to address those needs, anticipated effects to forest resources and protections needed to prevent significant impacts to resources."

In fact, there are no 'predetermined activities', only a predetermination that there will be an activity and any activity might occur at any given location to be determined at a later date. This is entirely insufficient to meet the requirements of NEPA and completely disregards the Forest Service's obligation to allow the public to comment on proposed plans and have those comments considered.

A review of VMAs that are denoted as 'with a sawtimber product' leads to an obvious question: Were these specific areas designated as such because there is valuable sawtimber in the VMA, or were the VMAs in dire need of restoration and it just so happens that they contain significant timber of commercial value? This is especially concerning where Rich Cove ecozones have been included in 'with a sawtimber product' VMAs. Having gone into the field and visited a number of such VMAs, I would conclude the former is true rather than the latter. In my small sample, I found that the rich cove forest was diverse, healthy, and did have oak regeneration. What it needed was fire, not timber harvest.

Section 2.1.2.2.2 Commercial Timber Harvest states: "The Proposed Action includes performing commercial timber harvest on an average of 500 acres annually. Commercial timber harvest would be emphasized in the areas identified as "VMA with a Saw Timber Product" (approximately 12,217 acres of NFS lands) shown on Figure 1 and Appendix A, but harvest of generally small and lower valued trees may also be implemented in the areas identified as "VMA without a Saw Timber Product" (approximately 17,301 acres of NFS lands) where management area and current markets allow a commercial harvest of a generally low-value timber product." This statement does not clarify, in any way, what the difference is between with and without sawtimber product - other than to note there is an emphasis on commercial harvest in the 'with a sawtimber product' areas.

It is that 'emphasis' which makes the use of commercial timber harvest extremely problematic. A reader might think that the purpose and need for the project, as stated in the USFS StoryMap and in the EA, was "The Grandfather, Appalachian, and Pisgah (GAP) Restoration Project proposes actions to restore fire-adapted sections of Pisgah National Forest and reduce wildfire risk to resources and nearby communities." But it seems that there is also the need to emphasize commercial timber harvest without any consideration (or discussion) of how that advances the purpose and need of restoring fire-adapted sections of Pisgah National Forest and reducing wildfire risk.

The EA notes a goal of 500 acres of commercial harvest annually for ten years. That's 5,000 acres over the life of the project. This represents nearly half of the total acreage of all VMAs. The EA doesn't make clear to the reader that nearly half of all lands marked as VMAs will be commercially harvested in 10 years. And the EA does not attempt to explain how those acres need to be harvested in order to fulfill the purpose and intent of the project.

Vegetation Management

Section 2 provides details about types of vegetation management and where they would be allowed to occur. But it's important to note that 'where they would be allowed to occur' is in any VMA if ground disturbing and anywhere if not ground disturbing.

Table 5. Summary of Commercial Timber Harvest Activities informs the reader that every single vegetation management 'tool' is allowed in all VMAs whether or not they are 'with' or 'without' a sawtimber product.

The methods described are very generic, and there is no explanation for the scale and scope of the methods. Regular shelterwood is simply described, but the reader cannot know what basal area is left after treatment or what further treatments might be needed and in how many years. Group selection doesn't describe the size of small groups, the timeline for re-entry, etc. The same is true for irregular shelterwood - how big are gaps, how many entries are needed, how is the stand accessed, and how are roads managed?

I attended an open house in Brevard, and the forest silviculturist couldn't provide any answer about specific treatments - regarding entries or BA retention, etc. - only that such decisions were to be made entirely based on field review at the time of implementation. This cannot satisfy the requirement for impact analysis in NEPA. The USFS simply assumes that implementation will be perfect and thus no impact will occur.

Section 2.1.2.2.4 Temporary Road Construction makes brief mention of the most impacting aspect of the GAP project - the construction and maintenance of roads. It is good that no permanent roads will be created - but it is simply not believable that there could be 500 acres of commercial timber harvest annually and only 2 miles of temp roads constructed. If everything is considered including skid roads and skid trails, that might be possible - but there's no analysis of impact from skid roads and skid trails so there must not be any needed.

Finally, this statement, "Temporary roads would be stabilized using BMPs and, in accordance with the Forest Plan Standard TA-S-08, decommissioned when no longer needed using techniques such as, but not limited to, removing drainage structures, re-contouring, and stabilizing the final slope," doesn't clarify much. Many of the described 'methods' or 'tools' will require multiple entries over many years. If a temporary road is built in year 1, does it stay on the land as 'needed' for however many years it takes to complete all the entries?

Implementation Process

This entire EA is premised on increasing 'scope and scale' by pushing necessary activities to an internal forest service review process. "The Forest Service would conduct a five-step implementation process to ensure that individual activities comply with all aspects of this EA and associated decision." I am not aware that this process has ever been determined to be NEPA compliant, and there is no mention of any place in the process for public participation, review, comment, or objection. This is simply not tolerable.

Each step is entirely internal to the Forest Service, including monitoring, reporting, and progress/goal reviews. The described steps seem to cover the required steps for NEPA analysis - so if all the steps required for NEPA analysis will still be completed, why subvert the NEPA process and create a new process outside NEPA? More importantly, why make that process entirely internal to the Forest Service after the EA and the expected Finding of No Significant Impact (FONSI) determination are closed? It seems that the Forest Service intends to prevent transparency and public participation rather than have an open and participatory process.

Section 2.1.4 Monitoring and Adaptive Management in no way provides assurance of an open and transparent process. "For the GAP Project, monitoring would inform the responsible official whether an activity is having its intended effect, and identify any needed adjustments if the activity is not having its intended effect or is causing unintended and undesirable effects." Why is only 'the responsible official' informed about monitoring? There is no requirement that the public be informed, nor any opportunity for the public to participate in any evaluation or re-evaluation of the project. The rough example of the monitoring and adaptive management protocol leaves much to be desired. There is no mention of how any information might be relayed to the public nor how the public might be brought into the process of adapting the goals and objectives - nor of assessing the performance of actions.

Action Alternatives

NEPA requires that a reasonable set of alternatives be considered by the responsible official. But as has been the case in recent Forest Service EAs, there are only 'Do everything' or 'Do Nothing' alternatives. Why weren't other alternatives considered? For instance, why not consider an alternative that emphasizes the use of prescribed fire but does not emphasize the use of commercial timber harvest? By not considering such an alternative, the Forest Service avoids discussion of trade-offs (benefits and risks) between alternatives. In fact, without reasonable alternatives, it is apparent that the Forest Service will not consider anything but the do everything approach. This highlights the significant bias of the Environmental Analysis, where the only conclusion can be a Finding of No Significant Impact in order to proceed.

"No additional key issues were identified during agency coordination, agency and tribal consultation, or public scoping. Therefore, the Forest Service determined no alternatives to the Proposed Action need to be evaluated."

In fact, there were key issues identified during scoping, but no consideration was given to them. Numerous comments during the initial scoping in 2022 highlighted the concern about lack of details regarding which activities will occur in any given location. All those comments were ignored, and the current EA carries forward the same ambiguity.

Affected Environment and Environmental Consequences

Regarding this topic, consider my substantive comment to be that the entirety of Section 3 is insufficient. It is simply impossible to properly analyze environmental impacts when the Forest Service cannot or will not specify what actions might occur at any given location at any time during the 10 years (and possibly longer) duration of this project. The section makes a brief mention of the requirement to assess cumulative impacts but does not actually address cumulative impacts.

The section notes:

"Unless stated otherwise for a particular resource or use, the effects analysis area includes the 12 counties overlapping the Project Area and utilizes the following effect intensity definitions:

Negligible – Effect that is at or near the lowest level of detection.
Minor – Effect that is detectable, but localized, small, and of little consequence to a resource.

Moderate – Effect that is readily detectable, localized, and has consequences to a resource.
Significant – Effect that causes substantial consequences to a resource."

All effects are evaluated to be negligible or in a few cases negligible to minor in both the No Action and Everything alternatives. Again, the Forest Service waves away the thought that any action might have more than a negligible impact on any resource. In fact, only the No Action alternative has a potential moderate (negative) impact with regard to wildlife. It is simply not believable, nor can it be supported by the very general evaluation in section 3, that logging 5,000 acres, burning nearly 200,000 acres, and conducting stand improvements on over 100,000 acres will never have anything more than a negligible impact on the environment and resources.

The purpose and intent of the impact analysis is not to come to the conclusion that nothing bad will happen at all – that's fantasy. Rather, the purpose and intent is to analyze all impacts, honestly consider their impact, no matter whether Negligible, Minor, Moderate, or Significant, and then provide a conclusion which acknowledges all the impacts and considers their cumulative effect.

Climate Impacts and Carbon Balance

The EA's treatment of climate impacts from the proposed extensive commercial and non-commercial treatments is relatively limited and lacks a comprehensive analysis. While the document acknowledges that forests play an important role in the global carbon cycle, it fails to provide specific calculations or estimates of carbon emissions or sequestration resulting from project activities.

The EA suggests that while there may be initial carbon emissions during implementation of the proposed actions, these would be temporary, and carbon will be removed from the atmosphere as forests regrow. However, this oversimplifies the complex dynamics of forest carbon cycles and the impacts of intensive management. The document doesn't adequately address the potential "carbon debt" created by harvesting and how long it might take for regrowth to offset initial emissions.

Given the scale and intensity of the proposed treatments, a more thorough and quantitative analysis of climate impacts is warranted. The document's treatment of this issue seems to downplay potential negative impacts while emphasizing potential benefits, without providing robust evidence to support these claims.

Current scientific consensus is that breaking even on the carbon balance at 60 years requires a level of efficiency in timber harvesting and processing that is well beyond current standard practices. It would necessitate significant technological advancements, a shift to renewable energy in forestry operations, and careful consideration of the end-use of wood products.

The EA should provide a more comprehensive carbon balance analysis that considers:

1. The full carbon cost of harvesting, including equipment use, transportation, and processing.
2. The time required for newly planted or regenerating trees to sequester an equivalent amount of carbon as the harvested trees.
3. The fate of harvested wood products and their expected lifespans.
4. The impact on soil carbon, which is a significant carbon pool in forest ecosystems.
5. The potential effects of climate change on forest growth rates and carbon sequestration potential.

Without this level of analysis, it's impossible to accurately assess the climate impacts of the proposed activities or to determine if they align with broader climate mitigation goals.

Roads and Access

The EA's treatment of road infrastructure and management is inadequate given the scale of proposed activities. The document states that up to an average of 2 miles of temporary roads would be constructed annually, with each road limited to a maximum length of 0.5 miles. However, it's unclear how this limited road construction will support the proposed 500 acres of annual commercial timber harvest.

The lack of a clear definition for "temporary roads" is concerning, as is the absence of a detailed plan for post-use management and restoration of these roads. The EA states that temporary roads would be stabilized using Best Management Practices (BMPs) and decommissioned when no longer needed, but it doesn't provide specifics on the timeline or methods for this process.

Given the potential for erosion, sedimentation, and long-term ecological impacts from road construction, even if temporary, a more comprehensive analysis of road impacts is necessary. This should include:

1. A clear definition of what constitutes a temporary road.
2. Detailed plans for road construction standards and post-use restoration.
3. Analysis of potential impacts on water quality, wildlife habitat, and forest fragmentation.

4. Consideration of cumulative impacts from repeated road construction and use over the project's lifespan.
5. Explanation of how the existing road network will be integrated with temporary roads to support project activities.

Monitoring and Public Involvement

The EA's provisions for monitoring, adaptive management, and public involvement are insufficient. While the document outlines some aspects of monitoring and adaptive management, the mechanisms for public reporting and assessment are not mentioned.

The EA states that monitoring would inform the responsible official whether an activity is having its intended effect and identify any needed adjustments. However, there's no clear indication of how this information will be shared with the public or how stakeholders can participate in the adaptive management process.

To ensure transparency and accountability, the EA should include:

1. A commitment to regular, public-facing reporting of monitoring results and project progress.
2. Clear mechanisms for ongoing public involvement in assessing project performance against goals and objectives.
3. Opportunities for public input on adaptive management decisions.
4. Independent third-party monitoring or assessment to verify Forest Service findings.

Without these provisions, it will be challenging for the public and stakeholders to assess whether the project is meeting its stated goals and objectives, and to address potential issues or concerns as they arise during the long-term implementation of this project.

Conclusion

In conclusion, while the GAP Restoration Project's focus on restoring fire-adapted ecosystems and reducing wildfire risk is commendable, the current Environmental Assessment falls short in several critical areas. The inclusion of commercial timber harvest as a primary tool appears misaligned with the project's core objectives and potentially counterproductive to its stated goals.

I strongly recommend that the Forest Service consider the following alternatives:

Alternative 1: Fire-Centric Restoration Approach

Remove commercial timber harvest as a management tool entirely.
Make prescribed fire the primary emphasis and main tool for ecosystem restoration and wildfire risk reduction.
Focus on developing a comprehensive, ecologically-based prescribed fire plan that accounts for the diverse ecozones within the project area.
Utilize non-commercial mechanical treatments only where absolutely necessary to support fire management objectives.
This alternative would allow for a more direct focus on restoring historical fire regimes and natural ecosystem processes, potentially accelerating the pace and scale of true ecological restoration.

Alternative 2: Targeted Vegetation Management without Commercial Emphasis

If some vegetation management beyond prescribed fire is deemed necessary:

Remove the emphasis on commercial timber harvest.
Focus vegetation management activities on specific, well-defined restoration goals such as: a. Enhancing species diversity in degraded areas b. Promoting oak regeneration where it is truly lacking c. Reducing fuel loads in high-risk areas near communities
Ensure all vegetation management activities are directly tied to explicit restoration or fire risk reduction objectives, with clear metrics for success.
Implement a robust monitoring and adaptive management program with regular public reporting and involvement.
This alternative would allow for more targeted interventions where needed, while still prioritizing ecological restoration over timber production.

For both alternatives, I recommend:

Conducting a more thorough analysis of potential environmental impacts, including a comprehensive carbon balance assessment that accounts for the full lifecycle of management activities.
Providing clearer mechanisms for ongoing public involvement and transparency throughout the project's implementation.

Developing more detailed, site-specific plans for proposed activities, particularly regarding any commercial vegetation management and temporary road construction.

I believe these alternatives would better ensure that the GAP Restoration Project truly meets its objectives of ecosystem restoration and wildfire risk reduction, while also aligning with broader environmental and climate mitigation goals. By focusing primarily on prescribed fire and removing the emphasis on commercial timber harvest, the Forest Service can more effectively and efficiently achieve its stated restoration objectives.
Thank you for your consideration of these comments and alternative approaches.

Sincerely,
Nicholas Holshouser

Appendix A: Fire First Alternative

This alternative would focus first on use of prescribed fire in those areas most at risk. Vegetation management would include ONLY non ground disturbing activities (such a selective thinning where trees are left in the woods) and would involve only minimal machine work to create adequate fire control lines. Follow-up treatments would be proposed based on post-fire assessment and perhaps multiple applications of fire are needed over many years. Proposed treatments would consider the 'new' forest condition after restoration of a more historical fire regime.

Key elements of the proposed approach:
1. Prioritize prescribed fire in high-risk areas
2. Limit vegetation management to non-ground disturbing activities
3. Minimal machine work for fire control lines
4. Follow-up treatments based on post-fire assessments
5. Consider multiple fire applications over 5-10 years
6. Base future treatments on the 'new' forest condition after fire regime restoration

Advantages of this approach:

1. Ecological alignment:
   - Mimics natural disturbance regimes more closely, especially in fire-adapted ecosystems
   - Reduces risk of inappropriate treatments in sensitive areas
   - Allows for a more nuanced response to different ecozones

2. Reduced environmental impact:
   - Minimizes soil disturbance and associated issues (erosion, compaction)

- Lowers risk of introducing invasive species through ground disturbance
- Reduces need for road construction in remote areas

3. NEPA compliance:
   - Focuses on restoration of natural processes, which aligns well with NEPA goals
   - Reduces complexity of environmental assessment by removing commercial timber harvest component
   - May qualify for categorical exclusions in some cases, streamlining the NEPA process

4. Adaptive management:
   - Allows for learning and adjustment between fire applications
   - Enables more responsive management based on observed ecosystem responses

5. Public perception:
   - May face less opposition due to focus on ecological restoration rather than commercial harvest
   - Aligns with growing public understanding of fire's role in forest ecosystems

6. Cost-effectiveness:
   - Potentially lower initial costs due to reduced need for heavy equipment and road construction
   - Long-term cost savings through reduced need for intensive management interventions

7. Scalability:
   - Easier to implement across larger landscapes due to reduced logistical complexity
   - Allows for treatment of remote areas that might be impractical for mechanical treatments

How this approach could advance pace and scale of fire treatments:

1. Streamlined planning:
   - Simpler NEPA process could allow for faster approval of projects
   - Reduced need for detailed site-specific timber harvest plans

2. Broader applicability:
   - Can be applied across a wider range of forest conditions and terrains
   - Less constrained by access limitations that affect commercial harvests

3. Increased public support:

   - Potentially faster implementation due to reduced public opposition
   - Opportunities for public education and engagement around fire ecology

4. Flexibility in implementation:
   - Ability to quickly adjust plans based on weather conditions and resources
   - Can take advantage of favorable burn windows across larger landscapes

5. Cumulative impact:
   - Allows for treatment of larger areas over time through repeated burns
   - Creates a mosaic of forest conditions that can enhance overall landscape resilience

Potential challenges and considerations:

1. Smoke management:
   - Increased prescribed fire use may face air quality concerns
   - Need for careful planning and public communication

2. Capacity building:
   - May require additional training and resources for prescribed fire implementation
   - Need for increased fire management personnel and expertise

In conclusion, this approach offers a promising path to advance the pace and scale of fire treatments while potentially reducing NEPA-related issues. By focusing on prescribed fire and non-ground disturbing activities, it aligns more closely with natural ecological processes and may face fewer regulatory hurdles. The adaptive, phased approach allows for learning and adjustment, which is crucial in complex forest ecosystems.

This strategy could significantly streamline the implementation process, allowing for treatment of larger areas more quickly. It also addresses concerns raised about combining ecozones in landscape-scale planning, as fire can more naturally adapt to site-specific conditions.

To maximize success, this approach would benefit from strong partnerships with air quality regulators, investment in prescribed fire capacity, and robust public education programs. While challenges exist, particularly around smoke management and initial implementation in high-fuel areas, the long-term benefits in terms of forest health, reduced wildfire risk, and simplified management could be substantial.

Research on Fire-Only Approaches to Management

There is research on fire-only approaches to ecological restoration, including studies specific to mesic oak and oak-pine ecozones.

Fire-only approaches in mesic oak and oak-pine ecozones:

1. Oak regeneration:
   - Hutchinson et al. (2012) found that repeated prescribed fires alone can promote oak and hickory regeneration in mixed-oak forests of Ohio, but effects were modest and required multiple burns over 13 years.
   - Arthur et al. (2015) showed that fire alone was often insufficient to promote oak regeneration in mesic sites with a well-developed understory of shade-tolerant species.

2. Forest structure:
   - Knapp et al. (2015) demonstrated that repeated prescribed fires in Missouri Ozark oak forests reduced midstory density but had limited impact on overstory composition after 60 years.

3. Species composition:
   - Dey and Hartman (2005) found that periodic prescribed fire alone was not effective in restoring shortleaf pine-oak woodlands in the Missouri Ozarks, particularly in more mesic sites.

Comparisons with combined mechanical and fire treatments:

1. Oak regeneration:
   - Brose (2014) showed that shelterwood harvests followed by prescribed fire were more effective at promoting oak regeneration than fire alone in Appalachian oak forests.
   - Iverson et al. (2017) found that mechanical thinning combined with repeated prescribed fire was more effective than fire alone in promoting oak and hickory regeneration in Ohio forests.

2. Forest structure:
   - Waldrop et al. (2016) demonstrated that mechanical treatments plus burning were more effective than burning alone in restoring open woodland structure in the southern Appalachians.

3. Species composition:
   - Kabrick et al. (2014) found that mechanical thinning followed by prescribed fire was more effective than fire alone in restoring pine-oak woodlands in the Missouri Ozarks.

4. Fuel reduction:
   - Stephens et al. (2012) showed that mechanical plus fire treatments were generally more effective at reducing surface and ladder fuels than prescribed fire alone in various forest types, including oak woodlands.

Key findings and considerations:

1. Site conditions matter:
   - Fire-only approaches tend to be more effective in drier, more fire-adapted sites than in mesic conditions.
   - Hutchinson et al. (2012) noted that topography and site moisture strongly influenced the effectiveness of prescribed fire.

2. Fire frequency and intensity:
   - Single, low-intensity fires often have limited long-term impact.
   - Repeated burns over extended periods (10+ years) show more significant effects (Arthur et al. 2015).

3. Initial forest conditions:
   - Fire-only approaches are generally more effective when starting with open forest conditions or where shade-tolerant competitors are not well-established (Brose et al. 2013).

4. Management objectives:
   - For rapid restoration of open woodland structure or promotion of fire-adapted species in degraded stands, combined mechanical and fire treatments are often more effective (Waldrop et al. 2016).

5. Long-term perspective:
   - Fire-only approaches may require longer time frames to achieve restoration goals, especially in mesic sites (Knapp et al. 2015).

6. Ecological trade-offs:
   - While combined treatments may achieve restoration goals more quickly, they can also have greater short-term impacts on soil, wildlife, and understory plants (Stephens et al. 2012).

Conclusions:

The research generally indicates that in mesic oak and oak-pine ecozones:

1. Fire-only approaches can be effective for maintaining existing fire-adapted communities but may be slower or less effective for restoring degraded stands.

2. Combined mechanical and fire treatments are often more effective for rapid restoration, especially in stands with well-developed midstories of shade-tolerant species.

3. The effectiveness of fire-only approaches varies significantly based on site conditions, fire regime, and initial forest state.

4. Long-term, repeated prescribed fire is usually necessary for significant ecological changes in fire-only approaches.

5. In many cases, an initial mechanical treatment followed by a long-term prescribed fire regime may offer a balance between rapid initial results and long-term ecological benefits.

These findings suggest that while a fire-only approach can be effective in certain conditions, a flexible management strategy that can incorporate mechanical treatments when necessary may be more broadly applicable across varied site conditions in mesic oak and oak-pine ecozones. The choice between fire-only and combined approaches should be based on site-specific conditions, restoration goals, and available resources.

It is possible that the research has some inherent bias such as papers which 'prove' a hypothesis rather than papers which explore more open ended questions.

Potential biases in research approaches:

1. Confirmation bias:
   - Some studies may have been designed to confirm existing management preferences or theories.
   - For example, researchers with a background in silviculture might be more inclined to design studies that demonstrate the effectiveness of mechanical treatments.

2. Short-term focus:
   - Many studies are limited by funding and time constraints, potentially biasing results towards short-term effects that may not reflect long-term ecological processes.

3. Site selection bias:
   - Researchers might unconsciously select study sites that are more likely to demonstrate their hypothesized effects.

4. Publication bias:
   - Studies with "positive" results (i.e., showing significant effects) are more likely to be published, potentially skewing the overall body of literature.

Examples of different research approaches:

1. Hypothesis-driven studies:
   - Brose (2014) on shelterwood-burn technique: This study was designed to test a specific silvicultural approach, potentially biasing towards proving its effectiveness.
   - Hutchinson et al. (2012) on repeated prescribed fires: While testing specific hypotheses about fire effects, this long-term study allowed for observation of unexpected outcomes.

2. More open-ended, exploratory studies:
   - Knapp et al. (2015) on long-term fire effects: This 60-year study in Missouri Ozarks was more exploratory, allowing for observation of long-term trends that weren't necessarily predicted at the outset.
   - Arthur et al. (2015) on fire effects in mixed-oak forests: While having specific hypotheses, this study's long-term nature allowed for unexpected findings, such as the limited effectiveness of fire alone in mesic sites.

3. Comparative studies:
   - Waldrop et al. (2016) comparing mechanical + fire vs. fire-only treatments: This study was designed to compare different approaches, potentially allowing for more balanced conclusions.
   - Stephens et al. (2012) meta-analysis of fuel treatments: By synthesizing multiple studies, this work potentially reduced individual study biases.

Observations on research approaches:

1. Evolution of research questions:
   - Earlier studies (e.g., from the 1990s and early 2000s) often focused on proving the effectiveness of specific treatments.
   - More recent studies tend to ask more nuanced questions about the interactions between treatments, site conditions, and ecological processes.

2. Long-term studies:
   - Studies like Knapp et al. (2015) and Hutchinson et al. (2012) that span decades are more likely to capture unexpected outcomes and long-term trends.
   - These studies often evolve in their questions and hypotheses over time.

3. Adaptive management studies:
   - Some recent research incorporates adaptive management approaches, allowing for adjustment of treatments based on ongoing results.
   - These studies may be less biased towards proving a specific hypothesis and more focused on understanding complex ecological responses.

4. Meta-analyses and syntheses:
   - Works like Stephens et al. (2012) that synthesize multiple studies can help identify overall trends and reduce individual study biases.
   - However, they may still be subject to publication bias in the studies they include.

Conclusions:

1. Mixed landscape: The research in this field shows a mix of hypothesis-driven studies and more exploratory, open-ended research. Both approaches have value but may lead to different types of insights.

2. Evolving field: There appears to be a trend towards more nuanced, long-term studies that are open to unexpected outcomes, particularly in more recent research.

3. Bias awareness: Many researchers acknowledge potential biases in their work, discussing limitations and alternative interpretations of their results.

4. Complexity recognition: More recent studies tend to emphasize the complexity of forest ecosystems and the context-dependency of treatment effects, moving away from simple "proof of concept" approaches.

5. Need for diverse approaches: The most robust understanding comes from combining insights from hypothesis-driven studies, long-term observations, and meta-analyses.

To truly understand the effectiveness of different restoration approaches, it's crucial to consider a range of studies with different methodologies and time scales. While some bias is inherent in any research, the field of forest ecology and restoration appears to be moving towards more holistic, long-term, and adaptive approaches that are less focused on proving specific hypotheses and more on understanding complex ecological dynamics.

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Appendix B: AOI and VMA Mapping and Delineation

A review of the provided GIS data and subsequent field review of a number of VMAs raises questions about the process used for selection as well as the applicability of the GIS data to guide the project.

Areas of Interest (AOI) are understandably large and cover diverse ecozones. AOIs highlight areas of focus primarily for fire activities, but within AOIs are specific Vegetation Management Areas (VMA) that delineate treatment areas where ground disturbing activities are allowed.

I analyzed the GIS data to look at the distribution of ecozones within each VMA and to better understand how the VMAs mapped to areas of potential need for restoration. I also considered FSVeg stand data to know vegetation type and stand age for the VMAs. What I found was that a typical VMA might overlay many FSVeg stands and contain distinctly different age classes and vegetation/ecozones. This does not make sense to me. If VMAs are meant to delineate treatment areas it would make more sense to align them with ecozones and, by inference, EV_Code or vegetation. It would also make sense to align VMAs with FSVeg stands which have a consistent vegetation type and stand age. As it is I find many VMAs which overlay multiple FSVeg stands of significantly different vegetation and stand age. I don't see how it is possible to then use the VMA as a treatment area since there would be different treatments within the VMA depending on ecozone, vegetation, and stand age.

An example shows this situation.

Consider the VMAs PIS2013 and 2014 in the Pisgah District. Note a 'subVMA' is a part of the VMA which is a distinct FSVeg stand. So in the case of PIS2013 it overlays 5 different FSVeg stands.

VMA:PIS2013
Total Acres: 33.68
subVMA: PIS2013_01, PIS2013_02, PIS2013_03, PIS2013_04, PIS2013_05
EV Code: 3, 53, 42
EV Name: White pine, White oak-northern red oak-hickory, Upland hardwoods-white pine

Stand Age: 40, 106, 101, 120
Sawtimber: True

Overall Ecozones
Acidic Cove Forest: 9.38 acres (27.85%)
Rich Cove Forest: 1.88 acres (5.58%)
Dry Oak/ever. heath: 4.85 acres (14.40%)
Dry-Mesic Oak: 14.79 acres (43.91%)
Montane Oak Cove: 1.09 acres (3.24%)
Mixed Oak/rhodo.: 1.88 acres (5.58%)

VMA: PIS2014
Total Acres: 20.44
subVMA: PIS2014_01, PIS2014_02, PIS2014_03
EV Code: 3, 53, 42
EV Name: White pine, White oak-northern red oak-hickory, Upland hardwoods-white pine
Stand Age: 40, 106, 101
Sawtimber: True
Overall Ecozones
Acidic Cove Forest: 2.27 acres (11.11%)
Rich Cove Forest: 0.87 acres (4.26%)
Dry Oak/ever. heath: 2.05 acres (10.03%)
Dry-Mesic Oak: 8.29 acres (40.56%)
Montane Oak Cove: 0.02 acres (0.10%)
Mixed Oak/rhodo.: 6.88 acres (33.66%)

Rather than having two VMAs, one which is all White Pine (the 40 year old stand) and one which is all White oak-northern red oak-hickory, Upland hardwoods-white pine the VMA was drawn so the the 40 year old white pine stand was 1/2 in each VMA. Thus, each VMA would have two different treatments. And both stands are extended into a portion of two different FSVeg stands where the canopy height shows large trees - seemingly only to include commercially viable timber. If those VMAs are harvested then you have two FSVeg stands which will each have two different age classes within them - will that get reconciled somehow in FSVeg?