MOVING TOWARD LANDSCAPE-LEVEL NEPA: BENEFITS OF ADVANCED TECHNOLOGIES, SPATIAL ANALYSIS AND COLLABORATIVE SCIENCE

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Abstract

The National Environmental Policy Act (NEPA), enacted in 1970, mandates environmental assessment, disclosure, and public input on virtually all proposed major federal actions regarding land use and natural resource management. In 2010, the White House Council on Environmental Quality proposed to "modernize and reinvigorate" NEPA to reflect forty years of practical experience, and to capture scientific and technological developments that enable powerful new approaches to environmental analysis. For example, geographic information systems (GIS) and remote sensing – coupled with spatial analysis and modeling – make landscape-scale analysis and planning a powerful and cost-effective alternative to traditional approaches developed decades ago. Furthermore, as large landscapes face increasing risks of uncharacteristic wildfire, prolonged drought, and the effects of climate change, there is widespread recognition for the need to plan and apply NEPA at the landscape scale, and with a collaborative approach that engages the public early and often in assessment and planning. We describe innovative approaches to landscape analysis and design that are compatible with NEPA and might increase its overall effectiveness and efficiency. Using advanced GIS and remote sensing techniques developed in response to increasingly sophisticated collaborative groups, the Lab of Landscape Ecology and Conservation Biology (LLECB) has supported stakeholders (public, private and agency) in several assessments of forested landscapes and restoration plans in Arizona and New Mexico. Here we present multi-scaled analyses from these assessments that have been tested in practice and, if adopted in formal NEPA analysis, might increase time and cost efficiencies. Results from these public efforts have identified priority areas for management and suggested actions that are scientifically grounded and reflect a high level of public deliberation and receive widespread support. Using these or similar approaches, land managers can work with stakeholders through all stages of the NEPA process, to identify needs, develop proposed actions, share information, assess landscape impacts, including cumulative effects and inform the selection of alternatives.

Background

The recognition that multiple environmental stressors, combined with reduced funding for land management and the push to "modernize NEPA implementation" (CEQ, 2003) highlight the emerging need for new, more efficient, cost-effective tools and techniques of accomplishing NEPA at much larger spatial extents. In southwestern forests, the risk posed by wildfire, the need for ecological restoration, the mandate for species-level conservation, and the call for greater transparency and public engagement all highlight the need for a new, landscape-level approach to NEPA analysis. New technologies in remote sensing and spatial analyses can span large areas and provide assessment and quantification of temporal change, spatial characteristics, structural relationships and biophysical interactions. These data can then be used to visualize ideas and management alternatives in a manner that integrates issues and involves diverse constituents in meaningful collaborative analysis. When grounded in a strong scientific design, the resulting products can be scientifically rigorous, transferable and repeatable.

Methods

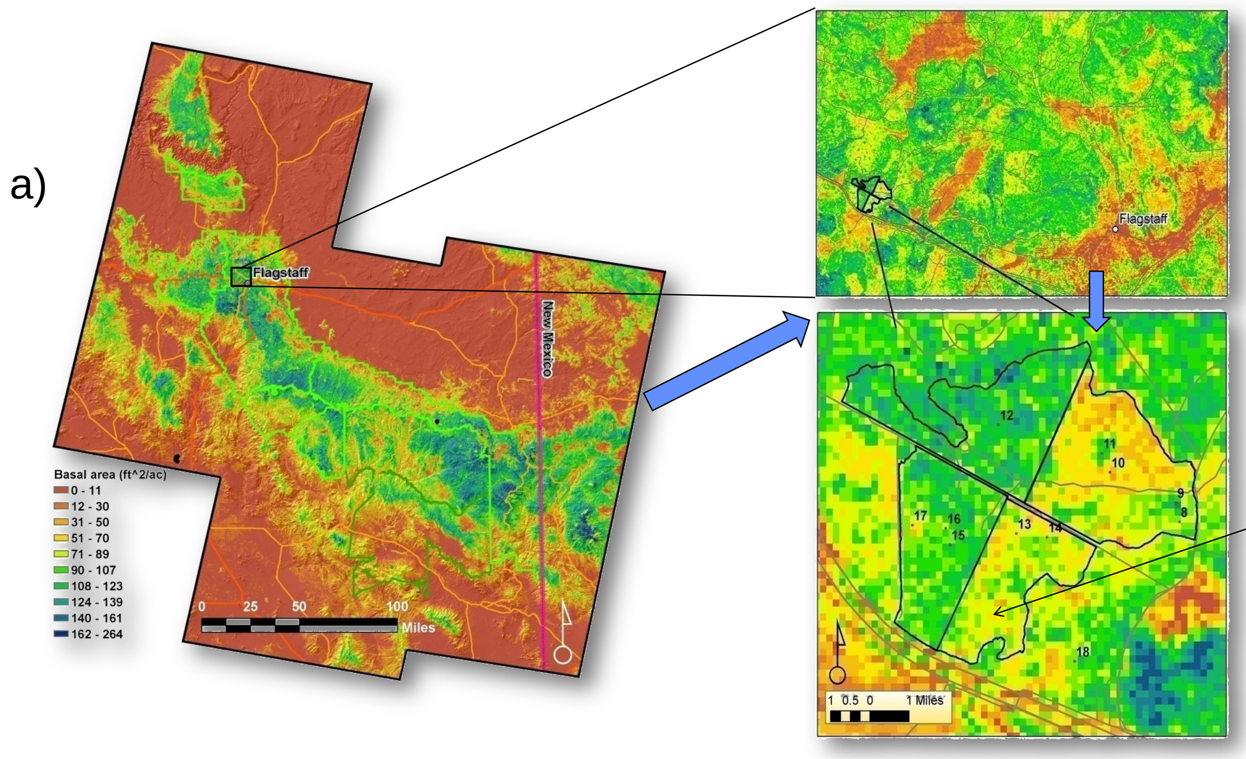
NEPA is both a "process" and set of "products" designed to evaluate environmental impacts of proposed federal actions that engages the public in a meaningful way with the goal of using rigorous and insightful analysis to inform land and resource management while maintaining transparency. As management challenges call for increasingly complex analysis over ever-larger areas, where there is a need to:

1. Increase analysis efficiencies across large areas while addressing multiple goals
2. Provide scientifically rigorous, flexible, transferable and repeatable analytical methods
3. Increase public participation at all steps in the NEPA process, including analysis

Here we provide case studies illustrating applications of advanced spatial analysis to address each of these areas of need. Together, they provide a practical initial roadmap for implementing NEPA at the landscape scale.

1) Efficiencies of scale. Investment in advanced remote-sensing and GIS can provide data resources, such as forest structure layers (basal area, crown bulk density, canopy cover, etc.) that become the basis for multiple and diverse NEPA-related analyses. Combining current and historic aerial and satellite imagery, these data allow quantification of the cumulative activities and disturbances over time and are foundational for other informative models, including fire behavior and risk, wildlife habitat and resource use, and landscape connectivity. Basing multiple analyses on a scientifically rigorous data source provides consistency among analyses and efficiencies of scale.

a)



Basal Area

Thin & burn –91ft²/ac

Faiella and Bailey, International Journal of Wildland Fire (2007)

Figure 1a. Satellite imagery derived basal area at the landscape, region and site scale (Dickson et al., in prep). One treatment, combining thinning and burning to reach values of 91ft²/ac, is highlighted, center, and a location photo of the treatment appears at right.

b)

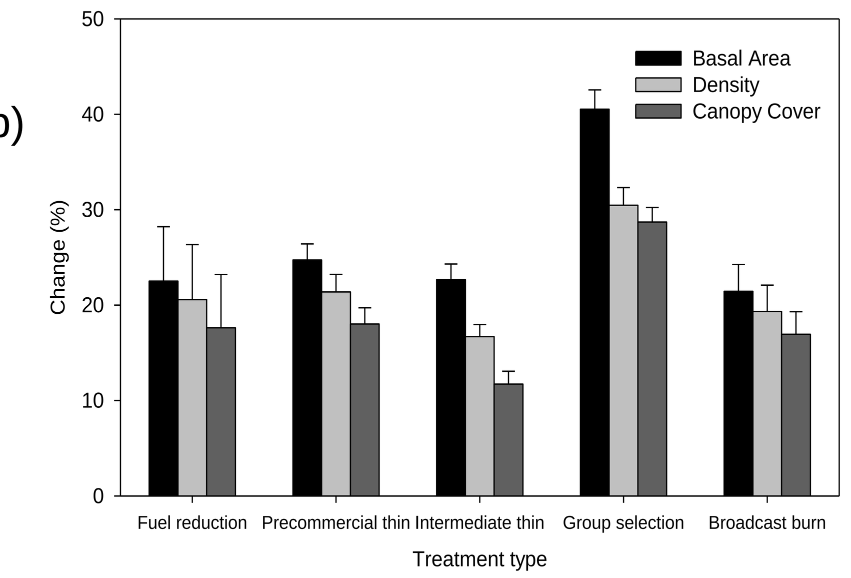


Figure1b. Percent change in forest structure variables estimate the impact of common treatment types, including small-diameter tree thinning, group selection, and broadcast burning implemented on the Kaibab National Forest 2007-2009. (Dickson et al 2011)

2) Science-based, rigorous, flexible and transferable data with repeatable methodologies. Transparency in data development, accessibility, and application is essential for supporting open and informed dialogue, a key element for success in landscape-level NEPA. Products should be well documented, available for independent review, and understandable to users at all levels. Hands-on access for spatial data consumers, and tangible maps for workshops, have all been used successfully to inform and engage participants in understanding, endorsing and using the data and products for numerous other work efforts, including projects under the Community Wildfire Protection Program (GFFP and PFAC, 2005) and the USFS Collaborative Forest Restoration Program, the Title IV of Omnibus Public Land Management Act of 2009. (http://www.fs.fed.us/restoration/CFLR/submittingproposals.shtml; Northern Arizona Forest Ecosystem Restoration Analysis).

a) **Developing a dataset that is scalable allows different questions to be asked of these same data.**

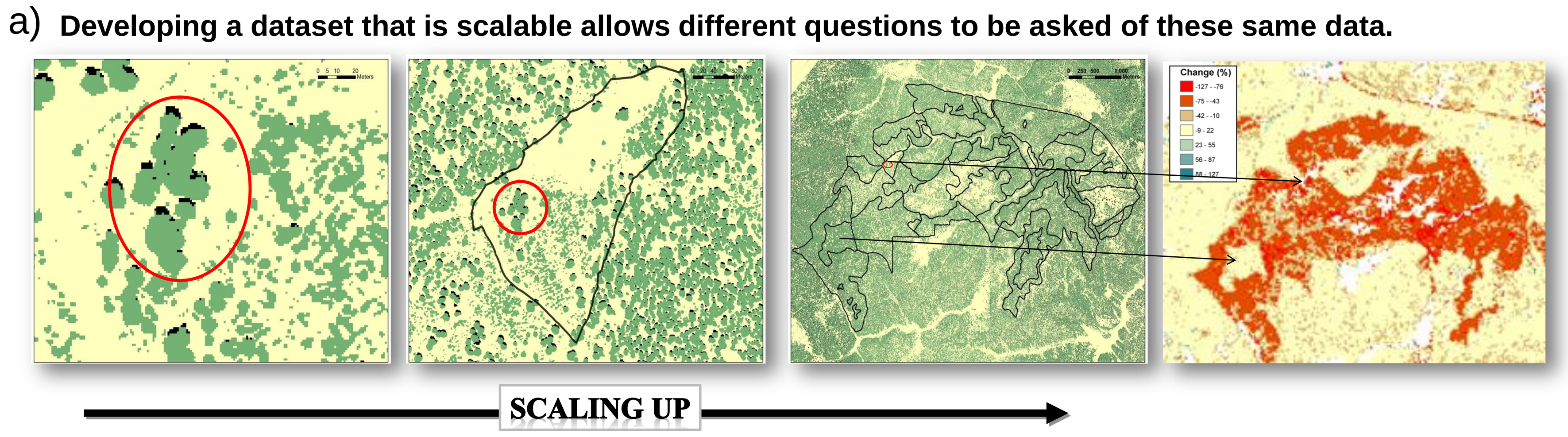


Figure2a. Tree canopy (green; scenes 1-3) derived from current aerial imagery. The circled (in red) grouping of tree canopy represent a different percentage of the landscape as one scales up to landscape-level planning areas. Black lines depict USFS tree stand boundaries and treatment areas. The last image depicts percent change in basal area after treatments across the planning area, as derived from satellite imagery.

b) **Alternatives can be modeled to predict impacts**

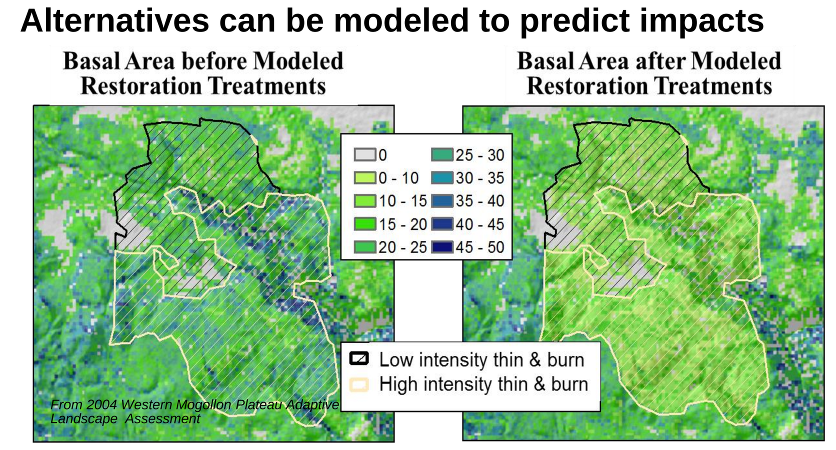


Figure2b. Estimated basal area pre- and post-treatment, as derived from satellite imagery.

3) Increased public participation with science through NEPA. Participatory analysis is the integration of public, private, agency and NGO stakeholders, supported by science and advanced spatial techniques. This approach provides landscape-level NEPA a productive collaboration with stakeholders early and often. It can 1) identify shared goals and values 2) build legitimacy through participation 3) create trust and credibility into the process, the products and among participants 4) provide new ideas and insights 5) support transparency.

Stakeholders' values and perceived risks to those values, were explicitly articulated in the 2005 White Mountains Landscape Assessment (Figure 3) which mapped the combined priorities identified by four working groups. The highest priority areas are shown in red. When overlain by the 2011 Wallow fire burn perimeter (black hatch), the power of science-based deliberation in generating critical insight and guidance for forest management is clear, and the consequences of inaction plainly illustrated.

More information on these can be found in the report from the 2005 White Mountains Landscape, available at http://forestera.nau.edu.

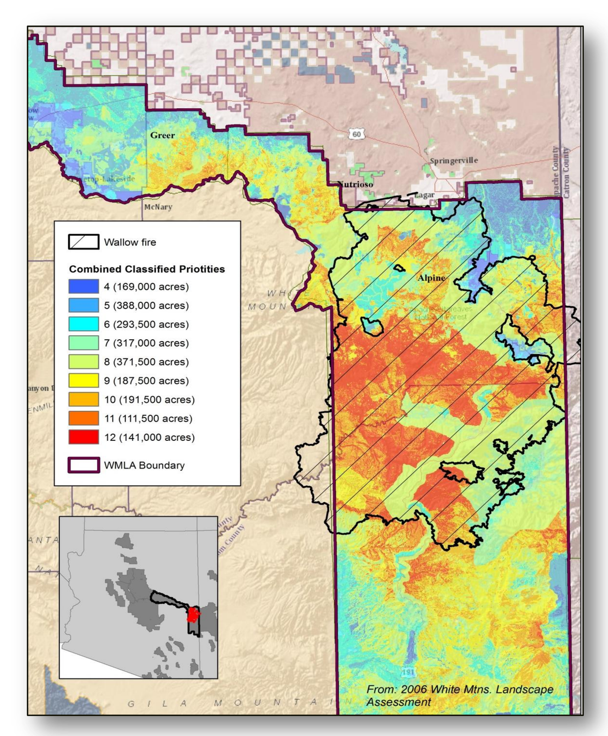


Figure 3. Results of Stakeholder-driven, spatially derived Value and Risk analysis, part of the 2005 White Mountains Landscape Assessment (Abrams et al. 2005), overlain with 2011 Wallow fire perimeter, 538,000 acres, the largest wildfire in Arizona history.

Discussion

Approaches for meeting the analytical objectives of NEPA developed in the years following passage of the act in 1970. After almost 40 years, minor adjustments to these approaches have fallen behind the pace of scientific and technical advances. A conceptual reassessment and investment in quantitative methods spatial analysis could yield marked improvements in accuracy, comprehensiveness, and efficiency. Improved processes for stakeholder involvement would also be supported by such an investment, and rigorous approaches to public engagement can lead to greater engagement and lesser conflict over NEPA analysis and planning. These analytical approaches, leveraging remote sensing and GIS technologies to support and create map-based formats for assessment, communication, and decision support "open up" the analytical process and provide an even playing field for all participants to articulate objectives and understand decisions affecting the landscape of which they are a part. Tangible results, in the form of spatial data products, can provide a basis for more informed discussion, deliberation, and refinement of ideas, improving analysis and building social capital to support management actions. These benefits are readily obtainable through proven analytical and deliberative methods, and thoughtful implementation at landscape scales is both practical and highly relevant to many current challenges in environmental management and conservation

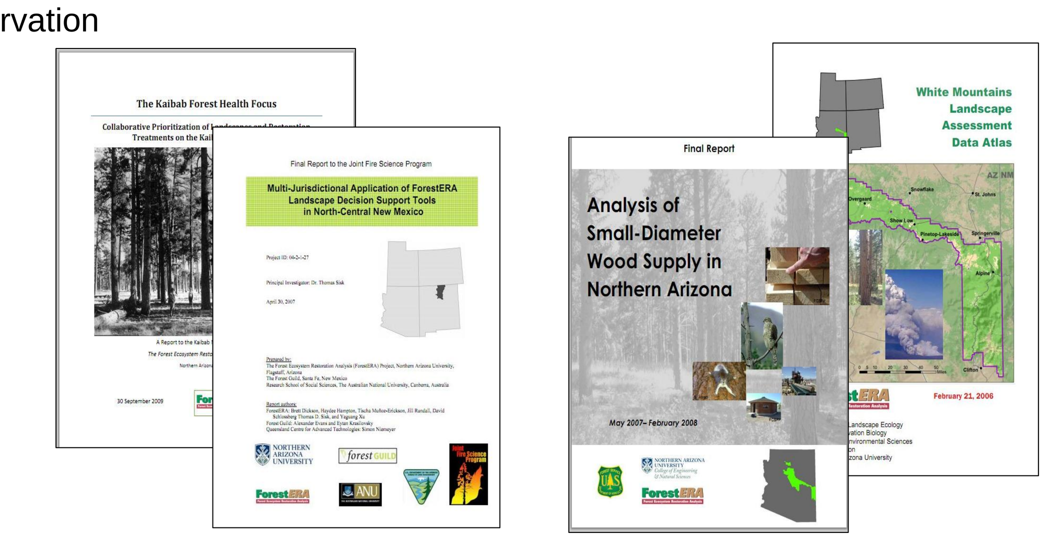


Figure 4. Sample of reports from science-supported collaborative landscape assessments in Arizona and New Mexico, that work that provides data and analytical foundations for landscape-scale NEPA analyses and related science-based collaborative efforts. (www.forestera.nau.edu)

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