Incorporating Resilience in National Forest Planning and Management

An EWP Quick Guide

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About the Ecosystem Workforce Program:

The Ecosystem Workforce Program is a bi-institutional program of University of Oregon's Institute for a Sustainable Environment and the College of Forestry at Oregon State University. We conduct applied social science research and extension services at the interface of people and natural resources. Our publications aim to inform policy makers and practitioners, and contribute to scholarly and practical discourse.

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Recent national forest policy direction, including the 2012 National Forest Management Act administrative regulations and the National Cohesive Wildland Fire Management Strategy, emphasize resilience and the achievement of resilient landscape outcomes. The resilience perspective considers ecological and social systems to be highly dynamic rather than stable and recognizes that they are subject to thresholds of change beyond which recovery is difficult or impossible. Resilience has been defined in various ways by academics and practitioners, and understandings of the concept have evolved over time. This can make it difficult for planners and decision-makers in the USDA Forest Service (USFS) to incorporate resilience concepts into forest planning and management. The goal of this quick guide is to help national forest planners and managers achieve resilient outcomes by clarifying the meaning of resilience and reviewing relevant lessons from recent research.

Through research methods that included a review of planning documents, case studies of recent forest plan revisions, and a survey of USFS planning staff, we have identified both challenges and possible solutions to the successful operationalization of resilience. This quick guide will offer lessons learned from these analyses along with tips for practitioners looking to put resilience into action. Examples of best practices will be highlighted in the form of **five key steps for improving the incorporation of resilience in national forest planning and management:** 1. Establish a clear definition; 2. Plan for change; 3. Embrace adaptive management; 4. Identify creative solutions for capacity; and 5. Manage with (rather than against) change (see Figure 1, below).

Figure 1 Overview of the key steps for improving the incorporation of resilience in national forest planning and management

1. Establish a clear definition

Resilience is a complex and far-ranging concept and there has been controversy as to its exact meaning. Our research found that USFS planners and managers were not always consistent or clear in their terminology and that many USFS employees felt that the agency's use of the term was unclear. For example, even within Environmental Impact Statement (EIS) documents that discussed resilience, only 30% included an explicit definition of the term. Including a clear definition is one way to increase understanding. Table 1 presents five definitions of resilience and closely-related concepts:

- **Resistance** can be a component of resilience; for example, overstory trees may resist low-intensity fire even as the forest ecosystem as a whole is altered by it.
- **Engineering resilience** focuses on the ability to return to a prior, equilibrium state following a disturbance. If a forest ecosystem "bounces back" quickly after the fire to its pre-disturbance state, it is demonstrating engineering resilience.
- **Ecological resilience** focuses on retaining core system components even while some aspects of the system adapt to change. This definition has been attractive for forest managers attempting to incorporate fire or other disturbance agents into management. However, an emphasis on change can be uncomfortable for some stakeholders, as it contrasts with a view of nature as stable and predictable.
- **Social-ecological resilience** is similar to ecological resilience but sees social and ecological systems as linked by feedback processes. It recognizes that human communities are also parts of the system, with needs that must be met and impacts that must be accounted for.
- **Transformability** recognizes that retaining current system characteristics is not always feasible or desirable and that we may want to transition systems toward desired trajectories.

Regardless of which definition is used, all participants should be clear about the version of resilience that is being employed. For example, the difference between trying to achieve engineering resilience and trying to achieve social-ecological resilience could result in very different management directions—an attempt to return to previous forest conditions after disturbance, or a new pattern that adapts while retaining valued elements of the system.

Table 1 Definitions of resilience and closely-related concepts

Resilience conceptualization	Definition
Resistance	The ability to absorb or withstand disturbance.
Engineering resilience	The speed and ease with which a system returns to its equilibrium state following a disturbance.
Ecological resilience	The capacity of a system to absorb disturbance and reorganize while retaining essentially the same ecological feedbacks and functions.
Social-ecological resilience	The capacity of an integrated social-ecological system to constructively incorporate and deal with disturbance.
Transformability	The ability to transition to an entirely different system when the existing system is not desired or is unsustainable.

2. Plan for change

Plan for change: resilience of what to what, for whom?

After an agreed-upon definition of resilience is reached, participants should determine what, exactly, they are hoping to make resilient, against what disturbance(s), and in what social context. In other words, **resilience of what, to what, for whom?**

- ***Resilience of what?*** When discussing resilience, it is important for planners and managers to clearly specify the system (or elements of the system) for which resilience is a goal. For example, this could be a population of a particular species, a fire-adapted ecosystem, or a particular set of social-ecological relationships (such as a rural economy based on a mix of forest products and outdoor recreation).

- ***Resilience to what?*** The change agents or disturbance agents under consideration should be specified (e.g. wildfire, flooding, bark beetles, etc.). It is valuable to distinguish between "pulse" disturbances which occur intermittently (such as windstorms or wildfires) and "press" disturbances (such as invasive species or climate change) which exert a cumulatively increasing effect on the system.

- ***Resilience for whom?*** There are, inevitably, questions of social value in the management of national forestlands. The way that resilience is defined can have implications for people and what they value on national forests. Both rigorous scientific information and an inclusive social process should be used to ground goal-setting and decision-making.

Plan for change: incorporating disturbance

As a concept, resilience is founded on the understanding that social and ecological systems tend to be dynamic rather than stable. Because of this, planning and management are most likely to succeed when they make room for disturbance, change, and even surprise.

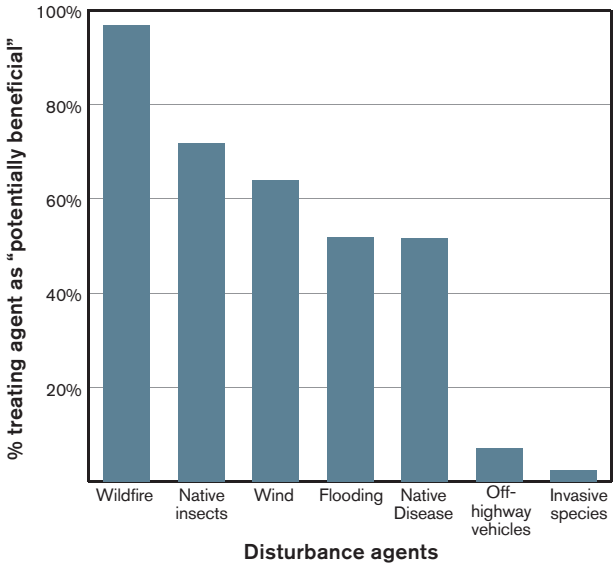
Many disturbance agents—from prevalent concerns such as wildfire, insects, and forest disease, to less obvious agents such as wind events and flooding—can possibly have positive effects on ecosystems and on some of their component species. Phenomena that appear to be destructive can be harnessed for management objectives, such as the establishment of stand diversity and the creation of a mosaic of land types.

This may be relatively easy to conceptualize in the case of fire, which is now broadly understood to be a vital part of many landscapes' ecological functioning. But what about other types of disturbance? Our research analyzed EIS documents to determine whether various disturbance agents were conceptualized as "potentially beneficial" or "destructive only." Chart 1 shows how often these disturbance agents were described as offering at least some potential benefits (expressed as a percentage of the EIS documents that included each disturbance agent).

Clearly, USFS planners broadly recognize that fire can have potential benefits in many systems, and other disturbance agents such as native insects, native diseases, flooding, and wind are often described as having potential benefits. Some suggested elements of planning for constructive change include:

- Discussing past histories of suppressing disturbances;
- Describing the potential benefits and impacts of various disturbance agents;
- Identifying thresholds, or ecological "tipping points" of change;
- Building agreement among various publics regarding valued system components.

Chart 1 How often disturbances were classified as potentially beneficial in EIS analysis



EXAMPLE

Plan for change: Wildfire as disturbance

Fire has been the ecological process of overriding concern on many national forestlands in recent years, and with good reason. Fire poses both grave dangers and ecological opportunities, depending on where, when, and how it occurs. Our case studies of recent forest plan revisions have revealed some successful approaches to improving resilience to wildfire, as well as maximizing the system benefits that wildfire can create.

Some forests found that simplifying their fire planning frameworks allowed for more flexibility in operations. The Rio Grande and the Francis Marion National Forests incorporated streamlined two-zone fire management approaches. For the Francis Marion National Forest, fire management areas included one in which prescribed fire would be used regularly to achieve resource benefits, and a second—closer to homes and other human infrastructure—that would see more limited use of fire, at least in the short term. This simplified system has allowed for implementation of a robust prescribed fire program despite the forest's proximity to rapidly-growing Charleston, South Carolina. In its plan revision the Rio Grand National Forest also adopted a simpler two-zone management system, with an emphasis on the management of naturally-ignited fire for resource benefits in areas isolated from private land, human infrastructure, or other values at risk. The Kaibab National Forest used its plan revision as an opportunity to create more flexibility for managing naturally-ignited fires for resource benefits.

3. Embrace adaptive management

As resilience has emerged as a guiding principle for resource management, researchers and practitioners have developed a decision-making framework to fit its needs. This framework, adaptive management, can help resource managers navigate toward more resilient outcomes. Adaptive management treats each management project as an experiment and as an opportunity to learn and incorporate lessons into future projects. It can be seen as a process of learning-while-doing that makes space for ecological surprise and indeterminacy, both of which are important aspects of resilience thinking.

The adaptive management approach can sometimes seem at odds with the legal, budgetary, and policy institutions that drive much of national forest planning and management. Any attempt to incorporate adaptive approaches will be imperfect and incomplete. Still, concrete steps can be taken to promote a more adaptive style of decision making:

Building trust with stakeholders

Adaptive management requires trust on the part of surrounding communities. Because adaptive management requires experimentation, learning, and adjustment, key stakeholders and partners must feel that their forest resources are in good hands. Many national forest units have built trust over the long term through processes of collaboration, partnerships, transparency in decision-making, and engagement of diverse stakeholders in planning, monitoring, and adapting.

Closing the adaptive management loop

A key element of adaptive management is treating each project as an experiment, taking advantage of monitoring and reflection to learn from past efforts. Interviewees in our case studies reported that monitoring is often under-funded and under-prioritized,

EXAMPLE

Building trust with stakeholders

At times, maintaining trust may mean consideration of values outside the boundaries of the national forest. For example, in 2017 the Kaibab National Forest decided to suppress the naturally ignited Government Fire, rather than allowing it to continue as a managed burn, despite its potential resource benefits. This decision was made in consideration of the large amount of smoke that surrounding communities had already experienced that year. A Kaibab National Forest manager commented on the value of accumulated trust between the national forest and surrounding communities:

> *"...we've had bad days. We've had unintended outcomes. To still have public support and partner support, after some of that stuff, I think speaks to the relationships that we have."*

leading to a critical gap in the adaptive management cycle. Embracing adaptive management implies allocating sufficient monetary and staff resources to monitoring to allow for learning and adjustment. Multi-party monitoring efforts, which include key stakeholders from outside the USFS, have been used successfully in many cases to build trust and increase learning while also creating new monitoring capacity.

Building landscape-scale partnerships

Adaptive management is designed to work across multiple scales—thus calling for engagement at levels from the district to the forest unit all the way up to the regional scale. Several relatively recent policy tools support landscape-scale and cross-boundary planning and management. In our survey of USFS staff, respondents overwhelmingly felt that the Collaborative Forest Landscape Restoration Program, Joint Chiefs' Landscape Restoration Partnership, and Healthy Forests Restoration Act provided tools to help achieve resilient landscape outcomes. The Shared Stewardship initiative represents another opportunity to formalize partnerships for landscape-scale planning and management.

EXAMPLE

Building landscape-scale partnerships

Forests can take advantage of landscape-scale cooperatives that are primarily oriented toward knowledge-sharing. For example, information provided by the South Atlantic Landscape Conservation Cooperative (SALCC) was instrumental in the Francis Marion National Forest's plan revision process. Connecting to the SALCC aided planners' efforts to situate the forest in its landscape, establishing its local ecological value within a wider matrix of conservation lands.

Adaptive management versus trial-and-error

The adaptive management model represents a contrast to planning approaches in which project impacts and outcomes are assumed to be fully predictable in advance. It recognizes that knowledge gathered during the course of the project is indispensable as a source of learning to feed back into future management. Therefore, adaptive management values mistakes highly as potential sources of information. However, this process is different from "trial-and-error," which it may superficially resemble. Adaptive management is carefully structured for knowledge-gathering, built on clearly formulating assumptions and designing monitoring to test those assumptions—with the aim that the project will result in usable information about the relationship between actions and outcomes. The goal is to understand not merely which actions worked and which ones did not, but why. Engaging non-agency partners and stakeholders in adaptive management can result in collaborative learning, potentially helping to move past entrenched disagreements based in divergent assumptions about the consequences of management actions.

4. Identify creative solutions for capacity

The ability to characterize patterns, processes, and interactions for particular systems and model future outcomes is vital. National forest managers have often struggled to fill science gaps in the face of budgetary and capacity shortages. However, some national forest managers have demonstrated innovative ways to successfully expand their scientific and monitoring capacity despite constraints.

Partnering with science providers

Forest managers can make use of a wealth of research being undertaken by other entities. Universities, non-governmental organizations (NGOs), state agencies, USFS research stations, and the Eastern Forest and Western Wildland Environmental Threat Assessment Centers have all contributed important data, modeling tools, and analyses to recent forest plan revision processes.

Taking advantage of existing data sources

Existing data may be available to national forest planners and managers that can help fill information gaps. The Forest Inventory and Analysis (FIA) program[1] is one such resource. State and local agencies may also have programs dedicated to the natural heritage of their region that can provide relevant data on pertinent sites. The nationwide Fire Science Exchange Network[2] provides forums for the sharing of research, data, tools, trainings, and best practices specifically related to fire management and landscape resilience themes for different regions of the country.

Enlisting citizen scientists

Building a program of citizen scientists is a low-cost option for obtaining quality monitoring data. Depending on the engagement level of surrounding communities, citizen science can make up for shortfalls in monitoring needs and improve the depth and quality of relationships between national forests and nearby communities.

Establishing external advisory boards

Some forest units have convened independent boards of university, agency, and NGO scientists to provide advice in an unpaid capacity. Other forests have used multi-party monitoring boards to recommend, prioritize, and carry out monitoring on particularly complex or contentious projects.

[1] *https://www.fia.fs.fed.us*

[2] *https://www.firescience.gov/JFSP_exchanges.cfm*

EXAMPLES

Science capacity in forest planning processes

Intra-agency: As part of its forest plan revision, the Francis Marion National Forest used data from the Climate Change Resource Center,[3] provided by the USFS's Eastern Forest Environmental Threat Assessment Center via the Template for Assessing Climate Change Impacts and Management Options (TACCIMO). This tool aggregates up-to-date climate change science and relates it to forest planning and management needs. Additionally, the Francis Marion National Forest utilized findings from the Southern Research Station of the USFS and from the Santee Experimental Forest, located onsite within the forest.

Neighboring entities: During its forest plan revision, the Kaibab National Forest capitalized on data and analyses provided by researchers at Northern Arizona University in Flagstaff, for example through a project called The Kaibab Forest Health Focus. Its recommendations were used on a 500,000-acre forest restoration project. Input from NGOs like The Nature Conservancy and the Museum of Northern Arizona's Springs Stewardship Institute were also used for planning and monitoring.

Farther afield: The Rio Grande National Forest is situated in a more remote area than the Kaibab and Francis Marion National Forests; nevertheless, planning staff used data and analysis from entities such as Oregon State University, Colorado State University, and the USFS Rocky Mountain Research Station during the plan revision process.

Local users and indigenous expertise: All national forestlands have a history of human occupation and use. Nearby communities with ties to the land may have knowledge of the system that is highly relevant to managing for resilience. The Kaibab National Forest relied on contributions from multiple Native American tribes during plan revision, as well as on an ongoing basis during project-level management.

[3] *https://www.fs.usda.gov/ccrc/*

5. Manage with (rather than against) change

A resilience-based approach can appear to run counter to planning conventions that have been established since the passage of the National Environmental Policy Act and the National Forest Management Act in the 1970s. It calls for a more flexible, iterative approach, breaking from a stability-based mindset. Accordingly, methods of goal-setting and the definitions of operational success may need to be adjusted to take advantage of the contributions of resilience thinking.

Acknowledge and manage tradeoffs between short- and long-term goals

For much of the twentieth century, the USFS operated under an output-oriented approach, managing forests for goals such as maximum sustained yield of timber (while seeking to suppress disturbances that might complicate that goal). As the agency's mandate has diversified, some elements of a target-oriented operational strategy have persisted. Even where agency goal-setting has been broadened—into such aims as "restoring resilient landscapes"—agency incentives and pressures can still result in a focus on achieving performance metrics. It should be noted that a resilience approach in no way precludes forests from achieving measurable objectives such as fuel reduction or the sale of timber. The goal of restoring landscape resilience merely encourages a broader, cross-scalar perspective than is typically captured by standard performance metrics. Our plan revision case studies provided examples of planning decisions that have facilitated management for resilient landscape outcomes.

EXAMPLES

Forest restoration

The latest forest plan revision on the Francis Marion National Forest shifted restoration efforts from the commercially productive but ecologically less-valuable loblolly pine toward greater emphasis on longleaf pine, a species expected to be more resilient to climate change. The Kaibab National Forest used the plan revision process to reorient management direction toward restoration, drawing upon a large body of science developed since the prior plan was written. Its new plan also eliminated standards related to tree size-class distribution in restoration projects, an artifact of the timber orientation of the previous plan.

Fire management

Managing for resilience often involves restoring fire to forests, which can be a challenge because it is unpredictable and can cause considerable destruction if it escapes control. Operational flexibility in USFS fire management had been evolving prior to the agency's employment of resilience thinking, but the concept has given support to practices that incorporate the use of both prescribed and natural fire. The Kaibab National Forest has steadily increased acres burned in recent years, aided in part by a forest plan revision that allowed for more flexible fire management. But even this metric of "acres burned" has not been pursued as a singular goal to the exclusion of other values. In the aforementioned case of the Government Fire, immediate suppression was used, rather than a managed fire approach. The Francis Marion National Forest also used its plan revision process to enable a more aggressive approach to fire use—in this case, focused on prescribed fire. Implementation of the prescribed fire program has been supported by strong partnerships with the state of South Carolina and various NGOs.

Aligning incentive and reward structures

A challenge that was identified throughout our research was the tension between managing for long-term resilient outcomes and managing to meet short-term performance metrics (such as timber sold and acres treated for hazardous fuels). Misalignments between incentive structures and adaptive management can lead to frayed relationships with external partners, declining trust, and diminished partnerships. District- and forest-level staff are generally not able to change these incentive structures on their own, but it is important to recognize the limitations they pose and to be transparent with partners and stakeholders about tradeoffs. Respondents to our survey were evenly split as to whether they saw "acres treated" targets as helping or hindering the achievement of resilient landscape outcomes; on the whole, they were more concerned about conflicts between resilience-oriented management and the achievement of timber targets.

Manage under climate change with new tools

Resilience is being advanced as a key principle for the USFS partly due to its usefulness in contending with climate change. By acknowledging dynamism within systems and focusing on adaptation, the resilience concept is well-suited to working under shifting climatic and weather patterns. Many of the concepts emphasized here—from the importance of scientific capacity for monitoring and modeling, to adaptive decision-making processes, to increased flexibility in operational goalsetting—can help support management adjustments in the face of climate change.

An excellent suite of tools specifically designed to help forest planners and managers make those adjustments is available at the Climate Change Resource Center,[4] which includes, for example:

- *Watershed Erosion Prediction Program (WEPP):* the WEPP model consists of multiple applications that can estimate erosion and sediment processes on hillslopes and small watersheds, taking into account climate, land use, site disturbances, vegetation, and soil properties.

- *Seedlot Selection Tool:* can help users match seedlots (seed collections from a known origin) with appropriate planting sites based on climatic information. The Seedlot Selection Tool is a web-based mapping application designed to help natural resource managers match seedlots with planting sites based on climatic information.

- *Template for Assessing Climate Change Impacts and Management Options (TACCIMO)*: a web-based information delivery tool that connects climate change science with forest management and planning needs. It is currently expanding to include information on agriculture, rangeland, and livestock planning as well. Science content in TACCIMO consists of findings from peer-reviewed climate change literature.

[4] *https://www.fs.usda.gov/ccrc/*

Conclusion

National forestlands are indispensable to human communities for the provisioning of fresh water, wildlife habitat, forest products, recreation experiences, and cultural and spiritual values, as well as for employment opportunities. National forests harbor numerous species of conservation significance, protect wild landscapes, and can serve to develop and demonstrate sustainable resource management approaches. Ensuring the resilience of these forestlands is critical for ensuring the resilience of society at large.

Recent national forest policy has reflected a concern with promoting resilient landscapes through policies such as the National Cohesive Wildland Fire Management Strategy. This quick guide was created to identify both challenges and possible solutions to successful operationalization of resilience. This resulted in the aforementioned five key steps for resilience operationalization. The tips and best management practices in this guide can be used in concert with other resources and guides referenced here to help put resilience thinking into practice.

Additional resources

Climate Change Response Network. **Menus of Adaptation Strategies and Approaches.** https://forestadaptation.org/adapt/adaptation-strategies.

Peterson, David L., Connie I. Millar, Linda A. Joyce, Michael J. Furniss, Jessica E. Halofsky, Ronald P. Neilson, and Toni Lyn Morelli. 2011. **Responding to Climate Change in National Forests: A Guidebook for Developing Adaptation Options.** Portland, OR: U.S. Department of Agriculture, Forest Service. https://www.fs.fed.us/pnw/pubs/pnw_gtr855.pdf.

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Salafsky, Nick, Richard Margoluis, and Kent Redford. 2001. **Adaptive Management: A Tool for Conservation Practitioners.** Biodiversity Support Program: https://fosonline.org/wp-content/uploads/2019/01/AdaptiveManagementTool.pdf.

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Walker, Brian and David Salt. 2006. **Resilience Thinking: Sustaining Ecosystems and People in a Changing World.** Washington, D.C.: Island Press.

Walker, Brian and David Salt. 2012. **Resilience Practice: Building Capacity to Absorb Disturbance and Maintain Function.** Washington, D.C.: Island Press.

Other practitioner-based publications from this project:

All publications and more information on this research are available on the project website:

http://ewp.uoregon.edu/ForestResilience

Working Papers:

Abrams, Jesse, Michelle Greiner, Thomas Timberlake, Courtney Schultz, Alexander Evans, and Heidi Huber-Stearns. 2020. **Planning and Managing for Resilience: Lessons from National Forest Plan Revisions.** Working Paper 100. Eugene, OR: Ecosystem Workforce Program, Institute for a Sustainable Environment. http://ewp.uoregon.edu/sites/ewp.uoregon.edu/files/WP_100.pdf.

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Briefing Papers:

Abrams, Jesse, Michelle Greiner, Thomas Timberlake, Courtney Schultz, Alexander Evans, and Heidi Huber-Stearns. 2020. **Planning and Managing for Resilience: Lessons from National Forest Plan Revisions.** Briefing Paper 87. Eugene, OR: Ecosystem Workforce Program, Institute for a Sustainable Environment. http://ewp.uoregon.edu/sites/ewp.uoregon.edu/files/BP_87.pdf.

Coughlan, Michael R., Autumn Ellison, Jesse Abrams, and Heidi Huber-Stearns. 2020. **Land Manager Experiences with Resilience in National Forest Management and Planning.** Briefing Paper 88. Eugene, OR: Ecosystem Workforce Program, Institute for a Sustainable Environment. http://ewp.uoregon.edu/sites/ewp.uoregon.edu/files/BP_88.pdf.

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