Cumulative Watershed Effects of Fuel Management in the Eastern United States

CHAPTER 1.

Introduction to Synthesis of Current Science

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Preparation of this report was commissioned to a group of scientists and land managers by the U.S. Department of Agriculture Forest Service, for the purpose of synthesizing current scientific literature to answer an important question facing the managers of Federal, State, and private lands in many parts of the country: At the watershed scale, what potential cumulative environmental effects might result from implementing fuel-reduction activities on forested landscapes? The main body of this report is a compilation of their findings, including both what can and cannot be concluded from the current science.

An earlier synthesis on this topic (Elliot and others 2010) focused primarily on fire regimes, vegetation types, and management practices in the Western United States. Several participants in that initial effort recommended a parallel report focusing on eastern landscapes, species, practices, and conditions. This report is the result of that recommendation. Although western fire conditions tend to be more dramatic, eastern conditions are as important, albeit more subtle. Human uses, particularly those since European settlement, have significantly changed most of the eastern landscape, including its vegetation form and distribution (Nowacki and Abrams 2008). This report reflects these subtle but important changes.

Our synthesis is organized somewhat differently from its western counterpart. The report contains 14 chapters grouped into 3 main topic areas. Chapters 1 through 4 set the stage, providing background material to establish the context for the remaining work. To simplify the presentation, silvicultural types were grouped into several larger categories than the 26 generally accepted cover types (U.S. Department of Agriculture 1983). Chapters 5 through 9 discuss fuels management activities grouped by ecological divisions (fig. 1); the Warm Continental Division (210) and the Savanna Division (410) lack research information on fuel treatments and are therefore not included. Chapters 10 through 14 assess the effects of treatments on the ecosystems described in chapters 5 through 9, including physical, chemical, and economic consequences.

Here in chapter 1 we broadly describe fuel reduction treatments in wildlands and the concept of cumulative watershed effect analysis. For perspective we have referred to some of the primary laws and policies that influence the way that Federal land managers apply fuel reduction treatments and analyze cumulative effects.

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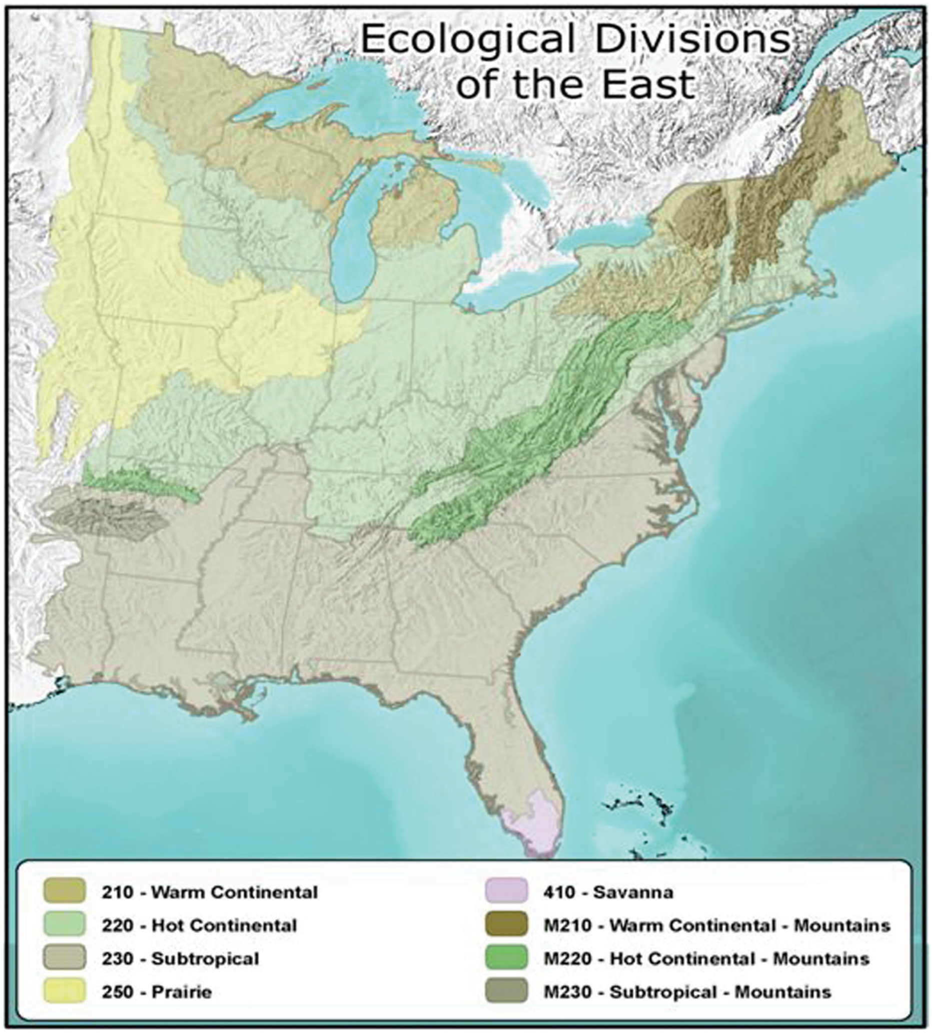

Figure 1. Ecological divisions and provinces of the Eastern United States (Cleland and others 2007).

Fuel Reductions Treatments and Policies and Laws Related to Them

Fuel reduction treatments are actions taken to reduce the threat of severe or intense wildland fire by manipulating live and dead vegetation to reduce the loading of fuel on the landscape. Fuel reduction can be accomplished in a number of ways, with the most common involving mechanical removal of fuel material (usually brush or trees), application of herbicides to reduce growth of undesirable species, and consumption of fuel using prescribed fire. These actions may be applied either alone or in combinations. Treatment of wildlands to reduce fuel was given a national mandate when the U.S. Congress passed the Healthy Forests Restoration Act of 2003. Efforts to reduce severe wildfire risk may be advanced by studies that link climate change to recent increases in the frequency and size of fires (Westerling and others 2006), raising concerns that this threat to U.S. forests may increase even further with expected changes in climate.

To effectively reduce the risk of wildland fires, fuel reduction treatments will need to be applied to large areas each year. In most circumstances, new vegetation will grow after treatments, meaning that maintaining low fuel stocking requires repeated treatments at intervals ranging from several years to a few decades. Where they are well designed and implemented, fuel reduction treatments can minimize the intensity of disturbance. However, they are carried out over many acres each year and require return treatments at regular intervals, producing project-level impacts that may be cumulatively significant at larger, watershed scales.

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Cumulative effects on watersheds might be caused by combinations of individual activities directly related to removing fuels (such as felling, skidding or chipping to mechanically remove fuel, and prescribed fire to consume it). Cumulative effects might also include the impacts of supporting operations or infrastructure at some distance from the actual site of fuel reduction. Examples of supporting functions include the movement of logging, fire control, and other vehicles used in fuel management. Examples of supporting infrastructure include roads, skid roads, and access landings as well as associated drainage ditches, culverts, and stream crossings. Although the landscape responses to short duration/high intensity disturbances (such as wildfire, final harvest, and site preparation) have been reported extensively, less is known about the effects of less intense treatments implemented repeatedly on large areas over an extended period. The research needed to fill these knowledge gaps is identified below.

In recognition of the critical role of wildland fire in forest ecosystems and the risk that high fuel loads pose in forests, the Federal government has taken several actions to accelerate fuel reduction treatments. Several policy initiatives by the Forest Service and other Federal agencies (the wildland fire policy of 1995 and cohesive fire strategy of 2000, the National Fire Plan of 2000, and the 10-Year Comprehensive Strategy and Implementation Plan of 2001 and 2002) were strengthened when President Bush announced the Healthy Forest Initiative in 2002.

What Are Cumulative Watershed Effects?

The National Environmental Policy Act (NEPA), requires that Federal agencies disclose the potential direct, indirect, and cumulative environmental effects of proposed alternative land management actions, and that they document those findings in a public report: an Environmental Impact Statement, an Environmental Assessment, or a Categorical Exclusion, depending on the nature and complexity of the action.

The basic premise of a cumulative effects analysis is to identify and consider the total effects of actions that overlap temporally or geographically and that could be missed if each action were evaluated individually. The goal of cumulative effects analysis is to provide decisionmakers and the public with comprehensive information about "the impact on the environment which results from the incremental impact of the action when added to other past, present and reasonably foreseeable future actions" (40 C.F.R. § 1508.7). Cumulative effects may arise from single or multiple actions that may be additive or interactive, direct or indirect. Cumulative effects are the net impact on watersheds of multiple management activities that may coincide geographically or temporally.

Although cumulative effects are defined by NEPA, cumulative watershed effects also come into play in the application of other environmental laws, although in more restricted circumstances. The Clean Water Act requires control of water-pollution nonpoint sources (pollution that does not have an easily identified source) as well as point (identifiable) sources, with particular emphasis on waters that States have designated as impaired (not meeting water quality standards) under section 303(d). Often, nonpoint sources are not easily attributable to well defined sources because they are geographically and/or temporally dispersed, and thus may be the result of cumulative watershed effects or may add to cumulative effects.

The Endangered Species Act protects species that are at risk of extinctions (listed under the Act as "threatened" or "endangered") from Federal-agency actions that could reduce their numbers or their habitats. Where listed species dwell in aquatic or riparian habitats, the risk may be the result of multiple management activities occurring at a watershed scale—the definition of cumulative watershed effects. These examples are not exhaustive, and laws such as the Clean Air Act and the National Historic Preservation Act have requirements of their own that may call for a cumulative-effects analysis under some conditions. If the consideration of cumulative watershed effects for complying with multiple laws becomes an issue for fuel reduction treatments on a particular landscape, a more comprehensive watershed-scale analysis that meets the requirement of all these laws might be warranted. The synthesis presented in the report

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may help by providing a scientific basis for developing such a comprehensive watershed analysis.

Evidence of Cumulative Watershed Effects

Because large-scale implementation of fuel reduction treatments has only begun recently, direct evidence of cumulative watershed effects is likely to be limited. However cumulative effects of other land management activities have been measured at watershed scales. A classic example comes from an extensive Columbia River basin study of fish habitat in 122 streams (McIntosh and others 2000): anadromous fish habitats that had been originally surveyed in the 1930s and 1940s were remeasured in the 1980s and 1990s. With the exception of streams in roadless watersheds, pools that were important stream habitat features for anadromous fish experienced significant declines over the intervening 60 years (for example, a 24-percent decrease in "large pools" and a 65-percent decrease in "deep pools"). An analysis of land management practices in these watersheds showed that no single practice or project was clearly responsible, but that a wide spectrum of land uses had occurred within the watersheds of the degraded streams, including forestry, grazing, urbanization, and road construction. It was the aggregate impact of all these practices—the cumulative effect of all the land uses—that had caused the habitat loss. By comparison, in watersheds with little or no change in land use over the period (watersheds with no roads), habitats had remained stable or had improved, reinforcing the hypothesis that cumulative effects of multiple land management activities had caused the degradation. The lesson from this study for large-scale fuel management is that widespread land management activities have the potential to cause significant, real impacts on aquatic systems in aggregate, even where the impacts of each individual, local project may be small or hard to measure.

Considering Cumulative Watershed Effects in Fuel Management

It is critical that cumulative watershed effects be considered early as part of planning and implementing fuel reduction treatments in the current legal and policy environment. Although the Healthy Forests Restoration Act did not waive NEPA analysis, it reduced the number of alternatives that must be considered and added requirements for public collaboration. A brief discussion of NEPA requirements follows; however, the purpose of this synthesis is to assess what valid scientific information is available to analyze the cumulative watershed effects of fuels reduction treatments, not to explain the legal requirements for documenting these effects. Interdisciplinary teams can use the information presented in this report to produce environmental documents at the appropriate level.

The Council on Environmental Quality[1] gave guidance on when to include cumulative effects in NEPA analysis (Council on Environmental Quality 1997); and stated in a recent memo, "except in extraordinary circumstances, proposed actions that are categorically excluded from NEPA analysis do not involve cumulative effects analysis" [www.nrcs.usda.gov/technical/ECS/environment/pastact.pdf (Date accessed: June 27, 2011)]. For the Forest Service, extraordinary circumstances are defined as the degree of environmental impact to seven resource conditions listed in the Forest Service Handbook 1909.15, Chapter 30, Section 30.3: steep slopes or highly erosive soils; threatened, endangered, proposed, and sensitive species or their designated or proposed critical habitat; flood plains, wetlands, or municipal watersheds; Congressionally designated areas, such as wilderness, wilderness study areas, or National Recreation Areas;

[1] Connaughton, James L. 2005. Guidance on the consideration of past actions in cumulative effects analysis. 4 p. CEQ memo. Available at: http://ceq.hss.doe.gov/nepa/regs/.

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inventoried roadless areas; Research Natural Areas; or Native American religious or cultural sites, archaeological sites, or historic properties or areas. Fuel reductions treatments that meet these requirements may not have to consider cumulative watershed effects.

Ultimately, it is the responsibility of the Forest Service leadership and employees to apply the broad set of laws and policies designed to create the intended effect of protecting the public from wildland fire, while at the same time complying with other sets of laws intended to protect natural resources and the environment. If members of the public disagree with specific management decisions, they have the right of challenge through appeal and in the courts. Within this changing legal and policy arena, methods for analyzing cumulative watershed effects are likely to remain important for natural resource managers. Cumulative effects are real, and sustaining multiple natural resources over the long run will require their consideration. Streamlining requirements for analysis under NEPA or other rules assumes that some practices have impacts that are either insignificant or small compared to the long-term benefits from a proposed action. Courts and public opinion will likely place the burden on land managers to demonstrate the validity of that assumption, using a standard for predicting outcomes that is usually based on current science.

Need for Decisions Based in Science

The scope and scale of fuels reduction treatments being undertaken by Federal land managers provide a strong argument for developing scientifically based methods to estimate potential cumulative effects readily available to practitioners. When decisionmakers must tackle projects whose scope and scale are beyond what they have experienced, any relevant body of science may be of little practical use unless it has been interpreted and articulated in a manner directly useful for addressing the problems at hand.

Potential Uses of this Synthesis

This synthesis of the current literature on cumulative watershed effects is a step towards developing useful methods for managers. It assembles in one place the current state of knowledge that was previously scattered across many sources. At the minimum it should provide managers, planners, and policymakers with a place to start describing the cumulative watershed effects of fuels treatments.

This synthesis, however, goes beyond being a central source of scientific information. Although cataloging and summarizing the literature are, in themselves, useful, this report goes further and anticipates questions that are likely to be posed by managers, planners, and policymakers. In this way, it identifies relevant questions the current science cannot answer as well as those that science can answer. The "science gaps" are at least as important as current knowledge because it is in these gaps that management and policy are vulnerable, and where caution is required because the results of actions may not be reliably predicted and may produce unforeseen outcomes. Identifying critical knowledge gaps also performs an important function for the science community. Such gaps can indicate productive areas for new research and development that have high potential both to advance scientific understanding and to serve the needs of the land management user community.

The value of this synthesis will depend strongly on how well it reinterprets existing knowledge in the face of new questions. Although it is true that a synthesis of the current literature may be a reworking of existing information, asking new questions of old data often casts them in new light. Thoughtful new questions may suggest new insights that have not previously been considered.

The questions considered here are indeed new because they involve the implications of a new management practice being applied on the landscape at expanded scales of space and time.

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Conclusions

We leave it to you, our readers, to decide how well this document meets your needs. As you use this document, you may find other pressing questions that we did not anticipate or address. We urge you to ask the science community to answer them. The value of this report will depend on its use; only through use will it serve its purpose of advancing the state of land management and policymaking and setting the stage for future research and development.

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