

San Diego Declaration on Climate Change and Fire Management: Ramifications for Fuels Management

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Abstract—Climate plays a central role in shaping fire regimes over long time scales and in generating short-term weather that drives fire events. Recent research suggests that the increasing numbers of large and severe wildfires, lengthened wildfire seasons, and increased area burned are, in part, related to shifts in climate. The historical fire regimes in many ecosystems have been disrupted. Efforts to restore ecosystem structure and integrity are facing both a changed fuel load condition and a changing climate. The San Diego Declaration on Climate Change and Fire Management attempted to consolidate a variety of perspectives on climate change and wildland fire management into a common statement on the overriding need to prepare and plan for wildland fire regimes of the future. These changes will not only directly affect wildland fire events, but also require a more proactive management of fuels to reduce potential disruptions to plant communities, fire regimes, and ultimately, ecosystem processes and services. The effective management of landscapes may require novel targets for community structure and compositions, even if the specific objectives for fuels treatments may focus on measure of resilience then the restoration of presettlement conditions.

Introduction

At the Third International Fire Ecology and Management Congress held November 13-17, 2006, in San Diego, CA, USA, the Association for Fire Ecology (AFE) presented a declaration on climate change and fire management for comment and approval. The draft presented at the Congress was the cumulative effort of many scientists within AFE as well as non-AFE members. About 200 signed the declaration at that time, and at the General AFE meeting held during the Congress, the membership of AFE also approved the declaration. The declaration attempted to consolidate a variety of perspectives on climate change and wildland fire management into a common statement on the overriding need to prepare and plan for wildland fire regimes of the future. While other forums have addressed the issue of global climate change (former Vice President Gore's movie "An Inconvenient Truth" and the more recent Intergovernmental Panel on Climate Change), this declaration was the first to approach the issue from the wildland fire perspective. Wildland fire regimes are likely to be significantly affected by global climate changes (Swetnam 1993), especially when changes in precipitation patterns (Grissino-Mayer and Swetnam 2000) and/or warmer climatic conditions (Williams and others 2001) occur. The result could be increases in the number of large fires and increases in the total area burned (Pinol and others 1998; Lefort and others 2003).

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It should be noted that the declaration represents the position of AFE and non-AFE member signatories and may not have represented the positions of organizations or agencies that sponsored the Congress. Since the Congress, the National Park Service (NPS) has launched a program to identify the most threaten resources and develop possible mitigations for future climate scenarios. In this context the AFE fire and climate change declaration has been embraced as an effective starting point to adaptive fuels management treatments designed for specific Park landscapes. The declaration has been widely distributed within the agency and is a point of specific discussion at multiple workshops addressing this issue. The declaration has helped to facilitate decisionmaking, up to the directorate level, regarding this complex and difficult issue. More recently Conservation Northwest has also endorsed the declaration.

The declaration begins with a preamble that addresses the overall issue of climate change, acknowledges the inability to identify the specific impact of climate change on specific ecosystems, and links potential changes to other important issues such as the wildland-urban interface. Some basic premises and then a short list of recommendations for research, education, and management follow the preamble.

Summary of Contents of the Declaration

Part One: Preamble

As scientists and land managers who focus on fire and its effects on natural ecosystems, we recognize that climate plays a central role in shaping fire regimes over long time scales and in generating short-term weather that drives fire events. The science surrounding human-caused climate change continues to strengthen, and the weather patterns that shape the ecosystems where we live and work may be altered dramatically over the coming decades. In anticipation of such changes it is important to consider how fire management strategies may enable us to respond to a changing global climate and thereby reduce potential disruptions to plant communities, fire regimes, and ultimately, ecosystem processes and services.

Currently, we are observing serious wildland fire conditions, such as increasing numbers of large and severe wildfires, lengthened wildfire seasons, increased area burned, and increasing numbers of large wildfires in fire-sensitive ecosystems (such as tropical rain forests and arid deserts). Recent research suggests that these trends are, in part, related to shifts in climate.

As temperatures increase, fire will become the primary agent of vegetation change and habitat conversion in many natural ecosystems. For example, temperate dry forests could be converted to grasslands or moist tropical forests could be converted to dry woodlands. Following uncharacteristic high-severity fires, seedling reestablishment could be hindered by new and unsuitable climates. Plant and animal species already vulnerable due to human activities may be put at greater risk of extinction as their traditional habitats become irreversibly modified by severe fire. Streams and fisheries could be impacted by changing climates and fire regimes with earlier peak flows, lower summer flows, and warmer water even if ecosystems don't burn. Finally, extreme wildfire events and a lengthened fire season may greatly increase the risk to human lives and infrastructures, particularly within the wildland urban interface.

We acknowledge that there are uncertainties in projecting local impacts of climate change. However, without taking action to manage fire-dependent ecosystems today and in the absence of thoughtful preparation and planning for the future, wildland fires are likely to become increasingly difficult to manage.

We, the members of the Association for Fire Ecology that endorsed this document at the Third International Fire Ecology and Management Congress, support the considerations outlined in this paper for planning and management to enhance ecosystem resiliency to wildland fire in a changing global climate.

Part Two: Background Premises

The second part of the declaration presents a number of premises that were the basis for the declaration. These premises begin with the acknowledgment of the role of fire as part of ecosystems as well as the historical disruptions of natural fire regimes. Additional premises address the potential impact of climate change on vegetation and the need to have proactive management programs to address climate change on ecosystems.

Both fire and climate regimes interact with other natural processes to direct the formation of vegetation in ecosystems. Given that climate and fire regimes are linked through vegetation, changes in climate can lead to large or small changes in fire regimes. Climate and fire regimes are also directly connected through the climate drivers of ignitions and fire weather. Climate influences both where and how vegetation grows and thereby creates the fuel conditions that drive fire frequency, intensity, severity, and seasonality. Precipitation and temperature patterns regulate the accumulation of fuels. In some ecosystems, wet years may promote “boom” vegetative (fuels) conditions, while drought years promote “bust” and the burning of the “boom” vegetation. Further, we know that the inevitable dry years, particularly when warm, are associated with larger fires, both in size and number, especially where fuel is abundant. Fire can also contribute to the problem of increasing green house gas emissions because it is a source of CO₂ and particulate emissions, which may affect local and regional air quality and worldwide climate.

Historical fire regimes have been disrupted in many ecosystems. Factors such as human activities and land development, loss of indigenous burning practices, and fire suppression have all led to changes in some plant communities historically shaped by particular fire regimes. Human activities have significantly increased the number of ignitions in many temperate, boreal, and tropical regions. Fuel loads have increased in some temperate forests where low intensity fires were historically the norm. In some rangelands, shrubs have been replaced by annual grasses or colonizing trees. Human-caused burning has increased fire frequency in some tropical regions where fire-sensitive ecosystems dominate.

Not all vegetation types have been significantly altered by fire suppression. Many shrubland ecosystems, such as California chaparral, burn with high severity under extreme weather conditions, and fire management in the 20th and 21st centuries has not appreciably changed their burning patterns. Coastal, mesic coniferous forests in the Northwestern United States have not been modified to a great extent by fire suppression policies because fire rotations in this area are much longer than the period of fire suppression. In other forests such as Rocky Mountain lodgepole pine, high severity fires

every 100 to 300 years are ecologically appropriate, and fire suppression has probably not affected these ecosystems to a great extent. The ecosystems most impacted by fire suppression are forests that once experienced regimes of frequent, low-moderate intensity fires; these ecosystems are probably the most vulnerable to altered fire regimes from changing climates.

Approaches to restore fire-adapted ecosystems often require treatment or removal of excess fuels (for example, through mechanical thinning, prescribed fire, or mechanical-fire combinations), reducing tree densities in uncharacteristically crowded forests, and application of fire to promote the growth of native plants and reestablish desired vegetation and fuel conditions. Excess fuels are those that support higher intensity and severity fires than those under which the particular ecosystem evolved or are desired to meet management objectives. For example, in dry Western U.S. forests that once burned frequently, a high density of trees and a large surface fuel load often promotes crown fires that burn over large areas. Some of these same forests once flourished under a fire regime where frequent, nonlethal low-intensity surface fires were the norm, and large-scale crown fires were rare. Managers should determine if forests can be restored to what they once were or if another desired condition is more appropriate. If it is not appropriate to restore ecosystems to a previous condition because of expected novel climate conditions, then managers should develop new conservation and management strategies and tactics aimed at mitigating and minimizing uncharacteristic fire behavior and effects.

Climate change may interact with other human activities to further change fire regimes. For example, in much of the Western United States, since the 1980s, large fires have become more common than they were earlier in the century. This has often been attributed to increased fuel loads as a result of fire exclusion. However, a number of research studies suggest that climate change is also playing a significant role in some regions, elevations, and ecosystem types. In the Western United States, researchers recently identified an increase in fire season duration in mid-elevation forests. These changes were correlated with earlier spring snowmelt dates. With global temperatures projected to rise throughout this century, increases in fire season length and fire size can be expected to continue.

Climate change can lead to rapid and continuous changes that disrupt natural processes and plant communities. Are managers safe in assuming that tomorrow's climate will mimic that of the last several decades? Increased temperatures are projected to lead to broad-scale alteration of storm tracks, thereby changing precipitation patterns. Historical data show that such changes in past millennia were often accompanied by disruption of fire regimes with major migration and reorganization of vegetation at regional and continental scales. Exercises in modeling of possible ecological responses have illustrated the potential complex responses of fire regimes and vegetative communities. These exercises indicate that dramatic changes in fire regimes and other natural disturbance processes are likely. Indeed, some believe that the impacts of climate change may already be emerging as documented in widespread insect infestations and tree dieoffs across some areas in the Western United States and British Columbia, and more rapid and earlier melting of snow packs. Developing both short- and long-term fire and fuels management responses that improve the resilience of appropriate ecosystems while reducing undesired impacts to society will be critical.

Changes in climate may limit the ability to manage wildland fire and apply prescribed fire across the landscape. Under future drought and high temperature scenarios, fires may become larger more quickly and could be more difficult to manage. Fire suppression costs may continue to increase, with decreasing effectiveness under extreme fire weather and fuel conditions. In some temperate and boreal regions, it is expected that more acres will burn and at higher severities than historically observed. In humid tropical regions exposed to severe droughts, vast forests could burn making it difficult for forest managers to prevent farmers from entering destroyed forests and establishing new farms. Globally, new fire regimes would be associated with shifts in ecosystem structure and function and, likely, changes in biodiversity.

Approaches to fire management that recognize the potential for greater variability and directional change in future climates may help to reduce ecological and societal vulnerability to changing fire regimes. Such approaches are likely to improve fire management and ecosystem health. A goal could be to reduce the vulnerability, both ecologically and socially, to the uncertainties that accompany a changing climate. For example, if managers restore some forests as a means to increase ecosystem resiliency to climate change, they will also be improving biodiversity and protecting important forest resources. In the humid tropics, if managers make a concerted effort to prevent fire from entering rain forests during drought years, then they would be reducing the risk of future fires and illegal logging, even if droughts did not become more frequent and severe with a changing climate.

Part Three: Considerations for Management, Research, and Education

The last section of the declaration presents some specific recommendations or considerations for management, research, and education. Fuels management is an important part of the suggested activities, since it is with fuels management that we can remediate ecosystems from past fire regime disruptions while also preparing for changes in those same ecosystems as a result from climate change.

Recent changes in climate and fire patterns have been observed in many areas of the world, and current projections are that ongoing and long-term changes are likely. We believe that the actions outlined below could help managers to be better prepared to anticipate and mitigate potential negative effects of variable and changing future environments.

Fire and ecosystem management

- Incorporate the likelihood of more severe fire weather, lengthened wild-fire seasons, and larger sized fires in some ecosystems when planning and allocating budgets, which traditionally are based on historical fire occurrence.
- Make use of both short-term fire weather products AND season-to-season and year-to-year climate and fire outlooks that are increasingly available from “predictive services” groups in Federal agencies, and particularly the sub-regional variations in anticipated fire hazards that enable strategic allocation of fire fighting and fire use resources nationally.
- Continually assess current land management assumptions against the changing reality of future climates and local weather events.
- Develop site-specific scenarios for potential weather events linked to climate change, and redesign fire management strategies to make room for rapid response to these events.

- Consider climate change and variability when developing long-range wildland fire and land management plans and strategies across all ownerships.
- Consider probable alternate climate scenarios when planning postfire vegetation management, particularly when reseeding and planting.

Fuels management

- Prepare for extreme fire events by restoring some ecosystems and reducing uncharacteristic fuel levels through expanded programs of prescribed burning, mechanical treatments, and wildland fire use to meet resource objectives. Burning under the relatively mild weather conditions of a prescribed fire produces lower intensity burns and, generally, less carbon emissions than would a fire burning under wildfire conditions. Burning and thinning treatments should be strategically placed on the landscape in locations where they are more likely to influence fire spread. Some ecosystems will continue to burn in high severity stand replacement fires, and this is appropriate for their sustainability.
- Incorporate emerging scientific information on the impact of changing temperature and precipitation on plant communities into fuels management project design and implementation at the local level.
- Expand wildland fire use at the landscape scale in fire-adapted ecosystems to restore fire regimes and reduce fuel loads. Be more aggressive in promoting fire use during lower hazard fire seasons, and fire use in landscapes that offer particular opportunities for relatively low-risk, large-scale burning. This will allow more acres to be burned under less extreme fire weather conditions than fires that might occur in the future under extreme heat or drought conditions.
- Control highly flammable nonnative plant species and develop management options to address their increased spread and persistence. In some ecosystems appropriately timed prescribed fires can be used to reduce nonnative species, while in others, continued fire exclusion may be the best management strategy. In some areas, reseeding and active restoration may be the best option.
- In some cases the removal and use of small diameter forest products (engineered lumber, pulp and paper, biofuels) and chipped fuels (for electrical energy generation) could be used to reduce fire hazards in appropriate vegetation types. Burning excess fuels in a cogeneration plant has the additional advantage of producing lower emissions when compared to prescribed fires.

Research, education, and outreach

- Implement long-term biodiversity and fuels monitoring programs in the fire-adapted ecosystems that are expected to undergo the widest range of change and variability linked to climate change, such as those that once experienced frequent, low-moderate intensity fire regimes.
- Expand interdisciplinary research to forecast potential fire season severity and improve seasonal weather forecasts under future climate change scenarios.
- Integrate the subject of climate change and its influence on ecosystem disturbance into curricula within natural resource management programs at the university and continuing education levels, and in science programs within primary schools.
- Disseminate information to the general public and government agencies regarding the potential impacts of changing climate on local natural resources and disturbance regimes, particularly those that interact with fire.

- Hold conferences or symposia to enhance communication among researchers and managers and to engage the general public in discussion on how best to adapt public land management to cope with fire in a changing environment.
- Form interdisciplinary teams of researchers that include fire ecologists and climate scientists to identify and pursue emerging areas of climate and fire research.

Conclusions

The San Diego climate change declaration was an attempt by AFE to enunciate how this issue may impact fire regimes across the country. The issue of global climate change will be in the forefront of worldwide discussions on land management for decades to come. For those of us involved in natural resource management, proactive management will be required to minimize the potential negative impacts of climate change. Fuels management is, and will be, one of the most important tools we have available. It is with fuels management that we can rectify the effects of past actions that resulted in modified fire regimes and restore both ecosystem sustainability and landscape-level processes. Fuels management will also give us the opportunity to mitigate potential negative effects of changing future environments.

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