Managing the Wildland–Urban Interface in the Northeast: Perceptions of Fire Risk and Hazard Reduction Strategies

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Abstract

Much of the recent work in reducing wildland fire danger has occurred in the western and southeastern United States. However, high-risk areas do exist at the wildland–urban interface areas in the Northeast and very little work has been done to understand the fire management issues in this region. Therefore, this study used a survey of residents and landowners within the Plymouth Pine Barrens of southeastern Massachusetts to assess community members’ perceptions of wildland fire risk and hazard reduction strategies. The research results indicate that residents have a low perception of wildland fire risk but support the use of fire hazard reduction strategies, including prescribed fire, mechanical removal of trees and brush, and construction of firebreaks. Previous experience with wildland fire was a major factor influencing respondents’ perception of fire risk. Furthermore, participants’ knowledge about specific fuel treatments positively influenced their support for these treatments. Overall, respondents believe that actions should be taken to reduce fire hazard within the study area and would like to be involved in the development of fire hazard reduction plans.

Keywords: wildland–urban interface—Northeast United States, homeowner perceptions—wildland fire risk, fire hazard reduction strategies

During the last 20 years, the number of catastrophic wildland fires occurring across the United States has increased. At the same time, an increase in the number of people settling in wildland areas has placed more homes at risk from wildland fires (Sampson 1999). The severe wildland fire season of 2000 resulted in a reexamination of the nation’s fire suppression policy and the development of a new National Fire Plan (USDA and US Department of the Interior 2000). One of the key elements of the National Fire Plan is the reduction of fire hazard at the wildland–urban interface across the country. Fire managers plan to focus fire hazard reduction work on communities that have been identified as being at high risk from wildland fire.

Although the northeastern United States typically is not considered to be at risk from catastrophic wildland–urban interface fires, threatened areas do exist (Pyne 1982). The federal government has identified over 200 communities within the Northeast as being at high risk from wildland fire (USDA and US Department of the Interior 2001). Pine barrens are one of the most common fire-dependent ecosystems in the Northeast and include scattered pitch pine, scrub oak, and ericaceous shrubs (Irland 1999). The coastal pine barrens support numerous rare plant and insect species that rely on repeated fires to prevent succession of vegetation to shade-tolerant forest types. Local land managers are interested in expanding the use of prescribed fire and other forest treatments to reduce fire danger and promote the pitch pine ecosystem. However, to date, little work has been done to reduce fire hazard or examine the local residents’ perceptions about wildland fire management issues held by residents. To address these issues, this study examined community member’s perceptions of wildland fire risk and fire reduction strategies in the Plymouth Pine Barrens of Massachusetts.

Research at the Wildland–Urban Interface: Fire Management and Public Perceptions

Researchers have found that perceptions about fire risk and hazard reduction strategies vary geographically and can depend on factors such as environmental knowledge, past experience with wildland fire, and length of residency. A study in southern California found that homeowners who had experienced a wildland fire supported mechanical strategies, such as firebreaks and clearing wildland vegetation, but were less supportive of regulations on private land (Gardner and Cortner 1987, Cortner et al. 1990). Likewise, Winter and Fried (2000) found that homeowners in a Michigan community affected by wildland fire gave little support to strategies that restricted existing property rights. Unlike the California study, respondents in Michigan did not support the use of prescribed fire. This can be attributed to their direct experience with an escaped prescribed fire that resulted in the loss of personal property.

Shindler and Reed’s (1996) study in Oregon discovered that local residents, many of whom were dependent on forestry income, overwhelmingly supported the use of prescribed fire and mechanical...
thinning of vegetation to reduce fire risk and restore the forest ecosystem. However, when asked to rank strategies, residents favored the use of mechanical thinning over the use of prescribed fire, possibly because of the economic benefits of increased logging.

Manfredo et al. (1990) found that the public appears poorly informed on prescribed fire policy and its effects. However, evidence suggests that as the media focuses public attention on fire policy issues, public knowledge has increased (Winter and Fried 2000). A Florida study found that residents became more supportive of prescribed fire programs after educational outreach (Loomis et al. 2001). There also appears to be support for involving the public in developing fire hazard reduction plans (Winter et al. 2002). There is a need to expand this research to the Northeast where conditions are different from other areas of the country.

Methods

Objectives

The objectives of this study were to determine community members’ perceptions of wildland fire risk, support for the use of fire hazard reduction strategies, and opinions about the role of the public in fire management in the wildland–urban interface in the northeastern United States. The goal was to provide local land managers with insights into public perceptions of fire management and assist them in fire hazard reduction planning. In addition, this study will be used to compare attitudes in the Northeast to those in other regions.

In particular, we were interested in looking at the relationship between local residents’ experiences and knowledge about wildland fire and management techniques and their attitudes. Because the region has seen an influx of new residents from more urban areas, we hypothesized that perceptions of fire risk would be low among homeowners. In addition, because the region has little history of prescribed fire use, we expected that there would be much more opposition to prescribed fire than other techniques such as forest thinning.

Study Area

This study was conducted in the Plymouth Pine Barrens located in Plymouth and Carver, Massachusetts. Plymouth has been identified as being at high risk from wildland fire by the federal government (USDA and US Department of the Interior 2001). The Plymouth Pine Barrens is approximately 50,000 ac in size, much of which is within the boundary of Myles Standish State Forest. The forest is a major recreational destination for residents of southeastern New England and includes 156 leased cottages located around several of the forest’s ponds. The area surrounding the forest is one of the fastest growing areas in Massachusetts (Steel 1999), with respective populations of approximately 15,000 in Carver and 45,000 in Plymouth (Massachusetts Department of Environmental Management 2001).

Myles Standish State Forest and the surrounding landscape have an extensive history of wildland fire. Before the arrival of European settlers in 1620, Native Americans probably used fires to control undergrowth to improve hunting grounds (Patterson and Sassaman 1988). Timber harvesting practices in the 1700s through early 1900s resulted in several large wildland fires (Massachusetts Department of Environmental Management 2001). Prevention of fires was one reason for the establishment of the forest. The largest fire occurred in May 1957 when a catastrophic fire burned 15,000 ac and destroyed about 40 structures. Another large fire in the 1963–1964 season burned 5,500 ac and destroyed the leased cottages on Charge Pond (Massachusetts Department of Environmental Management 1987). Since the 1970s, improvements in both firefighting equipment and fire roads within the forest have helped to further reduce the occurrence of large fires, although many small fires still occur (A. Mason, pers. comm., Massachusetts Department of Environmental Management, February 2002).

The development of residential subdivisions near the forest in recent years has increased the risk of property damage from wildland fires. In 2001, the Massachusetts Department of Environmental Management, using federal money from the National Fire Plan, began implementing fuel load reductions in Myles Standish State Forest including improving fire roads and firebreaks and performing one prescribed burn. However, the use of fire hazard reduction strategies are relatively new and little is known about local residents’ perceptions of risk from wildfire or their knowledge and level of support for various fire hazard reduction strategies.

Survey Instrument and Sample

To understand these issues, in spring 2002 a mail survey was distributed to a random sample of 497 seasonal and year-round residents and landowners within a 2-mi radius of the boundaries of Myles Standish State Forest in Plymouth and Carver, Massachusetts. The sample represents about 12% of the approximately 4,240 households and landowners located within the study area. The survey contained a combination of Likert-scaled and open-ended questions designed to measure respondents’ beliefs and attitudes toward wildland fire management issues. A total of 153 completed surveys were returned for a response rate of 32%. To determine the representativeness of the survey sample, demographic comparisons were made to the general population of the study area using 2000 US Census data. In general, the survey respondents are older, more highly educated, and earn a higher income than the overall population of the Plymouth–Carver area. In addition, the survey respondents contained a higher percentage of men (61%). These differences could be attributed to the fact that the survey was sent to property owners listed on tax records. Therefore, the results of this study need to be qualified to be representative of landowners but less representative of the overall population. Because the goal of the study was to learn landowners’ perceptions of these issues, this sample was considered adequate for further analysis. Also, because it was unclear if this sample had more or less knowledge about forest issues than the general population, this study was considered a pilot study for a larger, future research project.

Approximately 75% of the respondents are year-round residents and 25% are seasonal residents. The median length of residency was 20 years with approximately 25% of the sample having lived in the area less than 10 years. The majority of respondents use their property for residential uses with only 9.2% deriving any income from agriculture, forestry, or recreation. Almost one-half of the sample (46.7%) reported having experienced a wildland fire.

The survey respondents live in diverse residential settings. The majority of participants live in intermix forest conditions including older subdivisions with mature woodland trees (25%), scattered homes in the forest (23%), and older mobile home parks with mature trees (17%). Approximately 13% of the sample lives in newer subdivisions with wide roads and little vegetation that typifies a sharply defined wildland–urban interface. The remainder of the
sample owns seasonal cottages within the State Forest (17%) or large forest tracts (5%).

Results
Perception of Risk from Wildland Fire
The results of the survey revealed insights into participants' perceptions of risk from wildland fire, attitudes toward fire management strategies, and public participation in planning efforts to reduce fire hazard. Respondents were asked how likely it was that their property would be damaged or destroyed by wildland fire and to list reasons for their response to this question. Overall, survey respondents did not perceive a high risk from wildland fire with a mean score of 2.68 on a 5-point Likert scale (1 = very unlikely to 5 = very likely). As was expected, only a small percentage (14.5%) believe that it was likely or very likely that wildland fire would damage or destroy their property. Interestingly, the survey respondents did, however, indicate an understanding of how the surrounding landscape influenced risk from wildland fire. Those who perceived wildland fire risk as high most often gave the reason that their home or property was located in a heavily vegetated area. Respondents who perceived low wildland fire risk often indicated that their property was cleared of vegetation or was surrounded by natural or constructed buffers. In general, respondents perceived that natural barriers such as ponds also would protect their homes from wildland fire.

The low perceptions of wildfire risk are surprising considering that almost one-half of the respondents reported having personal experience with wildland fire. In fact, most respondents had experienced a fire burning close to their property and had seen smoke. Several respondents reported having memories of the catastrophic 1957 fire. A small number of respondents reported having assisted firefighters in extinguishing fires or having been evacuated from their homes.

Previous experience with wildfire did appear to play a role in respondents’ perceptions of wildland fire risk. Respondents who reported personal experience with wildland fire had a significantly higher perception of the likelihood of wildland fire risk (mean = 2.96) than did respondents who reported no experience with wildland fire (mean = 2.44; t = 3.21; P < 0.005). Seasonal residents who own cottages in the State Forest reported a higher likelihood of fire risk (mean = 3.16) than did respondents living outside the forest (mean = 2.58; t = 2.67; P < 0.01). This difference in awareness was most likely caused by past experience with wildland fires, because many cottage owners have vacationed in the forest for decades. Furthermore, many cottage owners expressed concern about the careless use of fire by recreational visitors.

Knowledge of Wildland Fire Hazard Reduction Strategies
To further understand the role of knowledge and experience, survey respondents were asked to rate their level of familiarity with fire hazard reduction strategies based on a 5-point Likert scale. The only information provided to the survey respondents was a brief definition of each strategy. Overall, respondents reported having some knowledge about prescribed fire, mechanical removal of trees and brush, and the construction of firebreaks. Surprisingly, respondents reported slightly higher levels of knowledge about prescribed fire than with other strategies (Table 1). This difference may be attributed to recent publicity about the use of prescribed fire by state agencies and The Nature Conservancy in Myles Standish State Forest.

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prescribed fire</td>
<td>2.93</td>
<td>1.09</td>
</tr>
<tr>
<td>Constructed firebreaks</td>
<td>2.65</td>
<td>1.11</td>
</tr>
<tr>
<td>Mechanical treatment</td>
<td>2.60</td>
<td>1.13</td>
</tr>
</tbody>
</table>

*Means are significantly different at the P < 0.05 level.

Table 1. Knowledge of fire hazard reduction strategies.

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Publicly owned land</th>
<th>Privately owned land</th>
<th>Significant P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constructed firebreaks</td>
<td>3.75 (1.13)</td>
<td>3.25 (1.33)</td>
<td>4.461</td>
</tr>
<tr>
<td>Mechanical removal</td>
<td>3.51 (1.17)</td>
<td>3.56 (1.20)</td>
<td>-1.363</td>
</tr>
<tr>
<td>Prescribed fire</td>
<td>3.49 (1.21)</td>
<td>2.99 (1.26)</td>
<td>4.86</td>
</tr>
<tr>
<td>Land-use regulations</td>
<td>N/A</td>
<td>2.91 (1.37)</td>
<td>N/A</td>
</tr>
<tr>
<td>No action</td>
<td>1.74 (1.26)</td>
<td>1.90 (1.24)</td>
<td>-2.771</td>
</tr>
</tbody>
</table>

Scale: 1 = none at all; 2 = a little; 3 = somewhat; 4 = a lot; 5 = a great deal.

Table 2. Support for the use of fire hazard reduction strategies based on land ownership.

Respondents' knowledge about fire hazard reduction strategies was associated with past experience with wildland fires, age, and residency status. Respondents who experienced wildland fires had a higher level of knowledge about constructed firebreaks (mean = 2.86) than did respondents that have not experienced fires (mean = 2.46; t = 2.26; P < 0.05). Younger respondents reported a higher level of knowledge about prescribed fire (mean = 3.43) than did older respondents (mean = 2.55; F = 3.34; P < 0.01). Seasonal residents were less knowledgeable about prescribed fire (mean = 2.63) than year-round residents (mean = 3.04; t = 2.03; P < 0.05).

Support for the Use of Fire Hazard Reduction Strategies

The next survey question asked participants to rate their level of support for the use of various fire hazard reduction strategies on both public and private land (Table 2). On public land, there was more support for using constructed firebreaks than mechanical removal or prescribed fire. Conversely, there was only modest support for the idea that managers take "no action" to address forest fuels. However, there was little support for imposing regulations (on private landowners) to reduce fire risk. When comparing management on public and private lands, generally, there was more support for taking action on public land than private land. Specifically, respondents expressed significantly more support for the use of prescribed fire on public land versus private land. This may be because of concerns about private landowners' ability to safely conduct prescribed fires. There was one notable exception; the leaseholders of cottages in the State Forest indicated significantly less support for prescribed burning on public land (mean = 2.96) than did the other respondents (mean = 3.60; t = -2.408; P < 0.05), presumably over concerns about the risk to their cottages.

To understand some of the reasons behind respondents' support for various fire hazard reduction strategies, a follow-up question asked their attitudes about more specific management options. The results indicated strong support for construction of additional firebreaks around the State Forest, as well as combining prescribed fire with mechanical clearing of brush and trees (Table 3). Respondents...
Their highest level of concern was the possibility of a prescribed fire escaping and becoming uncontrolled. Respondents also were somewhat concerned about the negative impacts of prescribed fire and mechanical treatment having negative impacts on wildlife. In addition, potential erosion from mechanical treatment was somewhat of a concern.

Several factors appeared to influence how concerned respondents were about risks with the use of fire hazard reduction strategies, including their level of knowledge about fire hazard reduction strategies and their experience with wildland fires. Survey respondents who reported at least some knowledge about prescribed fire were less concerned about appearance of burned areas after a prescribed fire (mean = 2.12) than were those respondents who were less knowledgeable about prescribed fire (mean = 2.70; F = 6.02; P < 0.000). Similarly, those respondents with a great deal of knowledge about prescribed fire were less concerned about the effects of prescribed fire on wild animals and wildlife habitat (mean = 2.98) than those with little knowledge about prescribed fire (mean = 3.74; F = 3.39; P < 0.05).

Respondents who reported firsthand experience with wildland fires had less concern about the risks of prescribed fire than other respondents. Differences in perceived risks included the impact of smoke from prescribed fires on nearby residents (respective means = 2.18 and 2.65; t = -2.06; P < 0.05), the potential for prescribed fires to escape (respective means = 3.19 and 3.72; t = -2.44; P < 0.05), and damage to wildlife habitat (respective means = 2.93 and 3.53; t = -2.48; P < 0.05). It is likely that those who have witnessed a fire in the area have some understanding of how fires burn and may not be as concerned as those who have never witnessed a fire.

Opinions about Public Participation in Fire Management Planning

It is important for managers to know if the public would like to be involved in natural resource management planning. Thus, the final survey question asked respondents their opinions about the role of public participation and education in the developing fire hazard reduction programs. The results of the survey indicate that there is very strong support from survey respondents for involving the public in fire management planning (Table 5). In fact, these questions received the highest ratings of any in the survey. Strategies for public involvement, such as using citizens’ advisory committees and focus groups also were rated very highly. In contrast, there was little support for allowing state and local officials to have sole responsibility for developing fire hazard reduction plans. Survey respondents also indicated their strongest support for educational programs for residents and property owners as part of fire hazard reduction programs.

Discussion

The results of this study showed that respondents’ perceptions of fire danger in the Northeast were somewhat low, except among...
those who had previously experienced a wildland fire. However, there was support for mechanical treatment and other fire hazard reduction strategies. The level of support for prescribed fire was higher than we originally hypothesized, considering the controversy of using this management tool in other regions (Pyne 2003). Previous experience with wildland fire and knowledge about the different fire management strategies were important factors that influenced participants' levels of concern about the impacts of management options, as well as their support for fire hazard reduction strategies. Participants in this study strongly supported involving the public in fire planning efforts.

Comparing this study's findings to fire research across the United States reveals regional differences in the influence of past experience of wildland fire on the perception of risk. Our findings in the Northeast indicate that those who have experienced wildland fires in the past perceive a higher risk than those who have never experienced fires. A study in northern Michigan by Winter and Fried (2000) also found that residents who had experienced a wildland fire had an increased awareness of the risk and believed that a fire would occur again. In contrast, Gardner and Cortner (1987) found that southern California residents who had experienced an intense wildland fire perceived wildland fire as less of a risk after a major fire. This may be related to the intense fires in California chaparral that consume all vegetation and the perception that it would be a long time until another fire was possible.

Regional differences also are found in local residents' support for fire hazard reduction strategies. The Northeast study found almost equal support for the use of prescribed fire and mechanical removal on public land. However, researchers in other regions have found differences in residents' preferences for fire hazard reduction methods. Shindler and Reed (1996) found that residents of northeastern Oregon had a higher level of support for the use of mechanical removal of trees and brush than prescribed fire. This preference was attributed to the importance of the forest products industry in the area and the belief that mechanical removal would benefit the industry. The Plymouth Pine Barrens, like many in the Northeast, is mainly residential and does not have a significant forest products industry. Therefore, promoting a forest-based economy may not be a consideration for the residents surrounding the forest.

An important research finding is the effect of knowledge on participants' support for fire hazard reduction strategies. Respondents who reported having a high level of knowledge of a specific fire hazard reduction strategy reported stronger support for its use. These study findings support previous research that found as knowledge about wildland fires and fire policy increases, support of prescribed fire policy also increases (Manfredo et al. 1990). Understanding the role of knowledge, as well as previous experience with wildland fire, has important implications for fire management planning at the wildland-urban interface.

Recommendations for Fire Management in the Northeast

The results of this study are useful to land managers in the Northeast as they develop programs to reduce the chances of catastrophic wildland fires and increase the education of residents about wildland fire risk. For example, land managers could conduct fire hazard risk assessments in at-risk neighborhoods to identify areas at highest risk as well as educate homeowners about actions that can be taken to reduce fire danger.

The results of this research project reveal that there is support among survey respondents for taking action to reduce the chances of catastrophic wildland fires in the Plymouth–Carver area. However, less support existed for the use of regulations that would require homeowners to take steps to reduce the risk from wildland fire themselves. Local land managers and fire officials may have to rely on voluntary programs to encourage private landowners to make their properties more defensible from wildland fire.

A major factor in survey respondents' support for fire hazard reduction strategies was their level of knowledge about the specific strategy and previous wildland fire experience. Thus, local land managers should conduct educational programs that show various treatments. Demonstrating the use of prescribed fire to local residents may help build support for larger-scale burns and show firsthand the positive benefits that prescribed fire can have for native ecosystems.

Survey respondents support citizen involvement in developing fire hazard reduction programs, which is consistent with current trends in natural resource management nationwide (Shindler et al. 1996). It is in the best interests of land managers to involve citizens in all stages of planning and implementation. Differences in perceptions about wildland fire risk and hazard reduction strategies appear to be influenced by factors such as residency status, age, and length of residency. Land managers should develop public participation strategies that involve stakeholders with diverse backgrounds to ensure that many different viewpoints are included.

The results of the survey indicate that there is little support for mandatory land-use regulations among respondents. Often, support for this type of regulation is highest after the occurrence of a catastrophic wildland fire. Future research is needed to understand which type of local land-use regulations, if any, would be acceptable to local residents. One idea may be to implement requirements for new construction in high-risk areas, including mandating public water supplies, access for fire vehicles, mandating particular roof materials, and selective clearing vegetation around structures. Local residents may support these measures because they would be applied to future development and not to existing residences.

The reduction of fire hazard in the Plymouth Pine Barrens, like other areas in the Northeast, will be a lengthy process. Meaningful reduction of wildland fire hazard will require a sustained commitment of resources and public support. It is likely that large-scale efforts to reduce wildland fire risk will require a combination of fire hazard reduction strategies including both prescribed fire and mechanical treatment of trees and brush, because the close proximity of homes to many high fuel areas makes widespread use of prescribed fire alone problematic.

As land managers consider implementing fire hazard reduction projects, building community support is essential to avoid opposition to programs on public land and to encourage landowners to reduce fuel loads on their own properties. The findings of this study can be useful in predicting community members' perceptions of wildland fire management issues and provide a starting point for future studies in the Northeast's other pitch pine-scrub oak barrens.

Literature Cited
