The Importance of Considering External Influences During Presuppression Wildfire Planning[1]

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Abstract

Few administrative units involved in wildland fire protection are islands unto themselves when it comes to wildfire activity and suppression. If not directly affected by the wildfire workload of their neighbors, they are affected by the availability of nationally shared resources impacted by wildfire activity at the regional and national scale. These external influences should be taken into account when local administrative units plan their presuppression organizations. Failure to account for the external influences of fire workload and resource availability can lead to incorrect assessment of local resource needs. Recent advances in fire planning technology funded by the National Fire Plan have made it possible to better account for these external forces. Testing this new fire planning technology on the Umatilla National Forest in eastern Oregon and Washington, we found common planning assumptions about the influences of external fire activity can lead to significant errors in estimating suppression program performance.

Introduction

A major function of wildfire planning is to prepare for the next fire season by choosing the type, number, and location of initial attack fire suppression resources to best meet management objectives within budget constraints. In addition, fire planners must develop policies and rules for deploying local resources and requesting resources in response to fire activity. Planning a fire suppression organization would be easier if it were reasonable to ignore fire events outside an administrative unit's border. Most administrative units, however, find wildfire related events and activities beyond their border frequently to have a significant impact on local initial attack operations and performance.

An administrative unit's interaction with the external fire environment arises in several ways. Mutual response arrangements may exist with neighboring protection organizations. Or, reliance may exist on nationally shared aerial resources, like smokejumpers and air tankers. In either instance, an administrative unit may find itself in competition for shared suppression resources during periods of simultaneous fire activity at regional and national scales.

To the degree these external influences exist, a fire planner would attempt to account for them in the design of the local initial attack organization. However, judging the magnitude, nature, and frequency of these external influences in the absence of extensive empirical analysis is fraught with many difficulties (Cleaves 1994). The designs of current planning tools, like the Interagency Initial Attack

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Assessment model of the National Fire Management Analysis System (USDA Forest Service 1985) widely used on Federal lands or the California Fire Economics Simulator (Fried and Gilless 1999), do not explicitly take into account the ebb and flow of fire activity and related events outside administrative planning boundaries. Not adequately considering these external fire activities can lead to misjudged presuppression needs.

A few approaches exist to address problems arising from the impact of external fire activities. One is to increase the geographic scale of planning so that fire workload outside the boundaries is minimal relative to that within. LEAPORDS (McAlpine and Hirsch 1999), a forest fire planning decision support system for the province of Ontario, is an example of this approach. Recent efforts to do interagency planning also increases geographic scale and, thereby, similarly reduce the relative importance of mutual response arrangements during planning. Even at this scale, presuppression planning is challenged by the issue of how to effectively deal with competition for nationally and regionally shared initial attack resources.

This paper presents the Wildfire Initial Response Assessment System (WIRAS), a simulation model that features the ability to examine performance of a local fire suppression organization within the context of regional fire suppression activities that affect the local availability of nationally shared aerial resources. We use WIRAS to quantify and overcome some of the biases arising from assumptions commonly made about external fire by local fire planners using planning models not designed to explicitly address influences of external fire events and suppression activities.

Model

As a planning technology, WIRAS combines many of the best features of its predecessors while adding new features that give it the capability of addressing fire planning issues arising from external wildfire forces. As a clock-driven, next-event simulation model, like those of Fried and Gilless (1988), Martell and others (1994), and Wiitala (1998), it expends considerable effort representing the spatial and temporal interactions of fire occurrence and initial suppression response. Similar to Fried and Gilless (1999) and Martell and others (1984), WIRAS addresses how the frequency and magnitude of multiple fire events should influence the complexion of the presuppression organization.

WIRAS differs from its predecessors by featuring the ability to plan fire preparedness programs at local, national, and mixed scales. It builds on earlier methods used to study nationally shared initial attack resource programs, like smokejumpers and airtankers, with their large geographic footprint (Wiitala 1998). With funding from the National Fire Plan, WIRAS tackled the problem of adding capability for intensive examination of a local suppression resource program within the context of the regional or national fire environment (Wiitala and Wilson, in press). Against several full seasons of historical fires, WIRAS simulates the initial attack process for all spatially and temporally located fires at both the local and regional or national geographic scales. As a result, during periods of concurrent fire activity at the different scales, the simulation model can account for impacts on local program performance arising from it having to compete for use of aerial resources shared regionally and nationally. This capability permits WIRAS to directly address the issue of accounting for external fire events and activities in local presuppression fire planning.

Methods

On the 1.4 million acre Umatilla National Forest in eastern Oregon and Washington, we use WIRAS to simulate the performance of initial attack suppression for three scenarios with different planning assumptions regarding the level of interaction with the surrounding fire environment of national forests in Northern California, Oregon, Washington, Idaho, and Western Montana. At one extreme, the isolation scenario, we achieve minimal interaction with the external fire environment by assuming no requests for suppression assistance from aerial resources off the forest. To simulate this scenario, WIRAS makes smokejumpers, airtankers, and external helicopters unavailable to the forest. At the other extreme, the optimism scenario, we assume external aerial resources are always available when requested, an assumption fire planners often make. The competition scenario falls between the extremes by assuming only uncommitted external aerial resources are available to the forest. In this latter scenario, the forest must compete for use of nationally shared aerial resources.

We distinguish the scenarios in terms of local suppression performance and external suppression resource use. Contained and escaped fire counts and burned acres provide our measures of suppression performance. The number of aerial resource deliveries to fires on the Umatilla NF measures external interaction.

To examine our scenarios, we selected the 1986 and 1994 fire seasons. The 1986 fire season contained a below average 4,520 fires for the fire area surrounding the Umatilla NF, but an above average 175 fires on the Umatilla NF. As shown in *Figure 1*, a high degree of concurrent activity existed between the two areas, primarily during two consecutive days where the Umatilla experienced nearly half its fires for the season. We also note that most of the fire activity during the peak period of August 10 and 11 (Julian dates 222 and 223 in *figure 1*) occurred from eastern Oregon through central and northern Idaho. This close proximity to the Umatilla NF caused heavy competition for nationally shared resources such as airtankers and smokejumpers. The many fires igniting in wilderness and roadless areas with limited accessibility to ground resources further exacerbated competition for aerial resources.

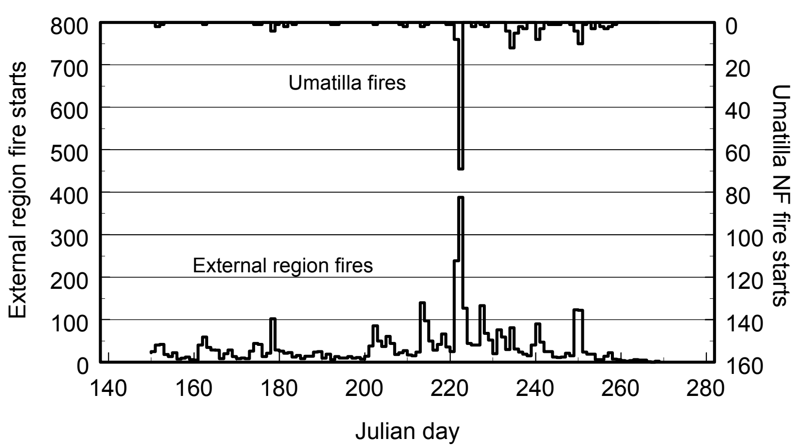

Figure 1—Daily fire starts in 1986 on the Umatilla National Forest and external region.

We selected the 1994 season to show that an atypically large number of fires at home (203) and beyond (6,943) do not necessarily pose a problem for a local fire suppression organization. *Figure 2* shows the Umatilla NF=s 1994 fire workload more evenly distributed over the fire season than in 1986. This was true for the external region as well. Compared to 1986, there was less dramatic coincidence in 1994 between the fire workloads of the two areas. We speculate that there would be less competition for aerial resources as a result.

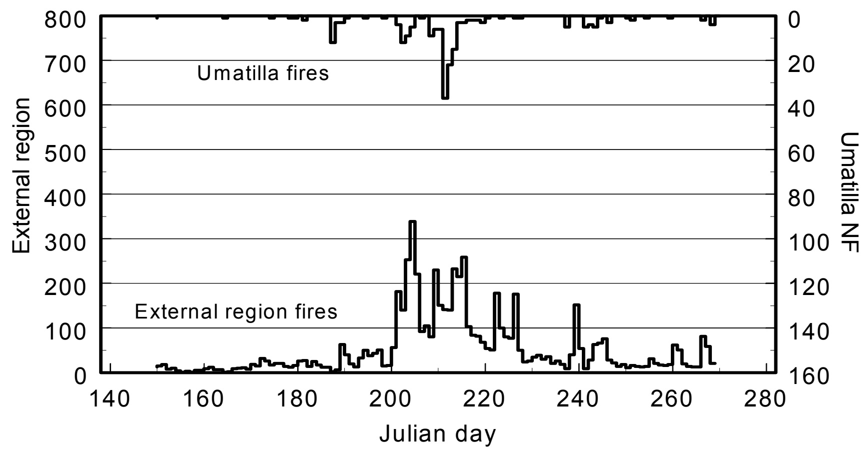

Figure 2—Daily fire starts in 1994 on the Umatilla National Forest and external region.

In our simulation runs, we use a local suppression organization that approximates what was in place on the Umatilla NF in 1994. Dispatch rules in WIRAS favor the use of ground resources over aerial resources when ground resource attack times are reasonable for the potential severity of a fire=s behavior and forest management objectives.

WIRAS currently meets most of its data needs with information in existing National Fire Management Analysis System (NFMAS) databases. In the case of the Umatilla NF, examples of these data include ground resource locations, attack times, duration of water for engines, and engine water retrieval times. Additionally, WIRAS relies heavily on a variety of fire related attributes available through NFMAS databases, like slope, aspect, elevation, intensity, spread, and fuel model. Suppression responses to fires are determined by the forests preplanned fire dispatches for management areas, fire danger levels, and single or multiple fire days (USDA Forest Service 2001).

Results and Discussion

The results of our simulations for the Umatilla NF=s two fire seasons show substantial contrast between years and planning scenarios. The 1986 fire season with its single, very heavy 2 day workload highlights the difficulties that arise in assessing suppression organizational needs when external influences are present. We start by looking at the competition scenario in which WIRAS competes to use shared aerial resources in the presence of significant concurrent external fire activity. The result we see in *table 1* is eleven escaped fires and 16,870 total burned acres. Umatilla NF actual fire history for 1986 shows twelve fires in excess of 100 ac and 13,805 total burned acres. Escaped burned acres are based on historical escaped fire sizes whereas contained burned acres are computed from elliptical fire size at containment.

Table 1—*Selected suppression performance statistics by scenario on the Umatilla NF for 1986 and 1994.*

		Numbers of fires		Burned acres		
Scenario	**Year**	**Contained**	**Escaped**	**Contained**	**Escaped**	**Total**
	1986					
Isolation		161	14	688	20,846	21,534
Optimism		171	4	439	5,596	6,395
Competition		164	11	491	16,379	16,870
Historical		165	10	651	13,154	13,805
	1994					
Isolation		200	3	527	4,467	4,994
Optimism		202	1	286	1,489	1,775
Competition		200	3	288	4,467	4,755
Historical		200	3	294	5,468	5,762

By contrast, the optimism scenario, with its assumption of external aerial resource always available upon request, results in a remarkable performance of just 4 escaped fires and only 6,395 burned acres. To achieve this outcome, use of smokejumpers and airtankers approximately doubles (*table 2*). The reduction in helitack use we suspect results from the greater availability and use of smokejumpers with quicker attack times. We point out that the optimism scenarios view of external resource availability, to the extent adopted, would lead to a false sense of security that could result in an underestimation of true local resource needs.

Although we mentioned earlier that a fire protection organization is seldom an island unto itself, the isolation scenario takes this position to the extreme by choosing not to use external aerial resources. *Table 1* shows, without any compensating increase in the ground resource organization, both escaped fires and burned acres increase about 28 percent over the results of the competition scenario. As expected, ground resources use was much higher here than in the other scenarios for both years (*table 2*). A look at the 1994 suppression performance results confirms our earlier speculation about the implications of magnitude and distribution of fire workload. Because of the more evenly distributed 1994 fire workload both on and off the forest, using just local ground resources in combination with the local helicopter (isolation scenario) gives a performance similar to the competition scenario which used available shared aerial resources. Both scenarios generate three escaped fire sizes (*table 1*). However, the lower number of contained burned acres in the competition scenario suggests use of external aerial resources leads to smaller fires.

Table 2—*Resource use by scenario on the Umatilla NF for 1986 and 1994.*

		Resource deliveries			
Scenario	**Year**	**Ground**	**Jumper**	**Helitack**	**Air tanker**
	1986				
Isolation		290	0	43	0
Optimism		253	71	37	85
Competition		250	29	45	47
	1994				
Isolation		340	0	39	0
Optimism		272	92	76	16
Competition		269	43	63	15

Looking at *table 1*, the optimism scenario again shows in 1994 that, if one assumes aerial resources were always available upon request, the result would look good on paper. However, the result would unlikely appear in practice. A typical planning response to the illusory and inflated performance of aerial resources would be to incorrectly trade off a part of the ground resource organization.

Conclusions

In this paper, we have highlighted some of the problems that can arise in the local initial attack fire planning process in dealing with the influences of external fire activity and resource availability. Current local fire planning techniques that do not model competing fire suppression activities beyond an administrative unit's boundary make assumptions about the availability of external suppression resources. In the WIRAS simulations presented here, we have shown that these assumptions, when taken to the extreme, can lead to flawed assessments of local resource needs. As we demonstrated in looking at the quite different fire seasons on the Umatilla NF, the severity of this problem for local presuppression fire planning is highly dependent on the dynamics of both the internal and external fire environment.

Statistically estimating the magnitude and nature of these external influences for meaningful use by existing planning models poses significant challenges, as well as research opportunities. As an alternative, local fire planning models could be modified to directly incorporate the influences of external fire activity and resource availability on an administrative unit's fire suppression performance, similar to the approach of WIRAS. This allows fire planners to plan their local organizations not only with respect to the dynamics of their internal fire environments, but also with respect to external fire activity which affects the availability of regionally and nationally shared initial attack resources.

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