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Wildland fire hazard and risk: Problems, definitions, and context

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Abstract

The risks, hazards, and relative severity of wildland fires are presented here within the ecological context of historical natural fire regimes, time, space, and process. As the public dialogue on the role and impacts of wildland fire increases, it is imperative for all partners to converge on clear and concise terminology that defines risk, hazard, and the characteristic (or uncharacteristic) nature of wildland fire. These terms must be defined in the context of scale—both spatial and temporal. The concept of historical natural fire regimes involves a classification of the characteristic, or ''natural'' processes and effects associated with wildland fire occurring in sustainable ecosystems. When a wildland fire occurs within the time, space, and severity parameters of the historical natural fire regime, the fire can be called natural, or ''characteristic''. The milieu of disturbance effects we call catastrophic, such as economic losses, damages to communities and structures, or impacts on short-term aesthetic values involve social, cultural, and economic values and risks—none is directly associated with ecological values, damages, or risks. In the context of technical risk assessments, the term ''risk'' considers not only the probability of an event, but also includes values and expected losses. However, within the fire community it refers only to the probability of ignition (both man- and lightning-caused). 'Hazard' refers to the state of the fuel, exclusive of weather or the environs in which the fuel is found. Unlike many common uses of the term 'severity', fire severity refers specifically to the effect a fire has on wildland systems. It is inappropriate to use the term severity to describe the behavior of the fire phenomenon itself. Instead, we should confine its use to that relating only to a fire's effect. Finally, I discuss the limitations and conflicts to integrating all social, cultural, economic, health, and safety values in our public and policy-forming dialogue relating to fire risk, hazard, and severity. Typical risk assessments consider all relevant endpoints, including socio-economic, management, as well as ecological elements. Herein, I use the Black Mountain 2 Fire from August 2003 in the northern Rockies to illustrate the spatiotemporal extent of fire's impacts on the endpoints. When expressed over all affected spatiotemporal scales, the overlay of all endpoints from this synthetic scenario results in a ''decision space'' ranging in time from an hour to a century, and in space ranging from a few square meters to the continent.

Keywords: Fire terminology; Fire hazard; Fire severity; Fire risk; Fire regime; Risk assessment

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''Life is lived forward but understood backward.''

Søren Kierkegaard

1. Introduction

Although Kierkegaard wisely advises that the past should inform one's understanding and grasp of the future, the uncharacteristic nature of many recent wildland fires seems to have diverted much of our attention to the present. We have found ourselves breathlessly describing the extraordinary behavior and extent of fires such as those observed in the autumn of 2003 near San Diego, California. Media attention on towering ''fire tornadoes'', the devastation of structures and communities, and the massive outlays of financial, human, and mechanical resources have quite effectively obscured our perception of the complex and diverse nature of fire we only recently began to acknowledge. As Maguire reminded us (this volume) on risk attitudes, ''the currency of events distorts our memory (and understanding).'' Clearly, the currency of the fires in southern California and elsewhere has distorted our memories. All fires are once again ''bad'' fires, most large fires are characterized as catastrophic, and our current attention has once again been diverted from the role of fire in ecosystem sustainability to an urgency for mitigation of wildfire risks, whatever they may be.

The current language used when addressing the perceived 'risks' and 'hazards' associated with wildland fire could be better understood by looking backwards to the very inception of forest policy in this country. In an 1899 article in *National Geographic*, Gifford Pinchot described this nation's forest legacy: ''The forest is as beautiful as it is useful . . . perhaps no other natural agent has done so much for the human race and has been so recklessly used and so little understood.'' Pinchot's article then characterized the relation of forests and forest fires, where he described fire as ''. . . one of the great factors which govern the distribution and character of forest growth'' (Pinchot, 1899). Early in the 20th century, even loggers and silviculturists were suggesting that fire was not always a ''risk'' to their stewardship objectives. In a bold article written in 1910 for the magazine *Sunset*, the California timberman George Hoxie stated that ''We must count on fire to help in the practical forestry . . . the practice invites the aid of fire as a servant [otherwise] it will surely be a master in very short time'' (Hoxie, 1910). And Harold Weaver, a 1940s-era silviculturist in northeastern Washington, noted the negative impacts of fire exclusion on management of ponderosa pine when he wrote, ''This [fire policy] has brought about changes in ecological conditions which were not fully anticipated, and some of which seem to threaten sound management and protection of ponderosa pine forests'' (Weaver, 1943).

The language we use to characterize resource management and, particularly, fire management appears to have become less concise over time. Perhaps, the diverse constituency expecting policy solutions to their perceived fire dilemma can only be acquiesced by holistic, all-inclusive language evolved through lumping, rather than splitting. For example, in 1998 the General Accounting Office (GAO) presented to Congress a comprehensive assessment of the wildfire threat to western national forests, but the final language used in the testimony seems to be couched largely in emotional terms driven by societal values, rather than ecological considerations:

''In 1995, the [Forest Service] agency estimated that 39 million acres . . . are now at risk of large, uncontrollable, catastrophic fires'' (GAO, 1998).

It is noted that, during the period of the GAO investigation leading to their 1998 report, the term catastrophic was regularly used by both the GAO and the Forest Service.

In his keynote address to the conference titled ''*Risk assessment for decision-making related to uncharacteristic wildfire*'', Forest Service Chief Dale Bosworth challenged us to facilitate the public understanding of the relative risks of wildland fire, and he provided three suggestions towards meeting this goal: (1) take the uncertainties into account; (2) weigh the risks without paralysis; and (3) translate into language the public understands. Unfortunately, we are sometimes so anxious to provide understandable language that we homogenize the information to the point that it loses any real value. For example, in the 1998 GAO testimony, the Forest Service and the GAO use common, understandable terms—large, uncontrollable, catastrophic—but at the price of losing any scientific basis for applying those terms to decision-making. On the positive side of these observations, we have recently made considerable progress in improving our language. The term ''uncharacteristic'' is now (fortunately!) the currency for describing fire processes occurring outside their biophysical baseline conditions. I note and commend the pervasive use of this term in the presentations and papers associated with this conference. Consider the likely possibility that a large, uncontrollable fire might well have catastrophic socio-economic consequences, yet could be well within the range of scientifically acceptable (characteristic) ecological consequences.

Further, I present various common interpretations of a number of fire-related terms and, where possible, suggest standardization based on a convergence of respected opinions. These terms include hazard, risk, characteristic (or not), and severity. Finally, I present a continuum of time and space within which the terms risk and severity can be considered. In this context, I will demonstrate numerous inconsistencies (and ambiguities) to the notion of an ''all-risk'' approach for wildland fire management.

2. The fire terminology

The terms hazard and risk have been formally associated with fire management in the United States since the inception of modern fire science in the 1920s. As early as 1916, research studies were underway toward the development of a scientific basis for forest fire hazard and liability evaluation (Hardy, 1983). Even now, there exists a considerable range of definitions both for risk and for hazard, and the metrics used to express the terms are equally varied. The most recent and most comprehensive synthesis of wildfire terminology has been prepared by Bachmann and Allgower (2000) for the Joint Fire Sciences Program Conference ''*Crossing the millennium*: *integrating spatial technologies and ecological principles for a new age in fire management*''. In their discussion regarding the confusion on proper usage of terms, they note, ''Moreover, the somewhat inconsiderate use of the various terms 'danger', 'hazard', and 'risk' may result in misunderstandings that can have fatal consequences'' (Bachmann and Allgower, 2000, p. 67). The term 'risk' is particularly elusive with respect to an acceptable definition, although the term, like 'hazard', has been in the fire nomenclature since the 1920s.

2.1. Fire hazard

Bachmann and Allgower (2000) note that the term 'hazard' can be used to not only represent the precondition for a specific process, but it can refer to the process itself. In that regard, wildfire is the hazard. However, when preceded by the word 'fire' (i.e. 'fire hazard') we have constrained the term to refer more specifically to the precondition. The recently revised Glossary of Wildland Fire Terminology produced by the National Wildfire Coordinating Group holds the most appropriate definition for fire hazard:

A fuel complex, defined by volume, type, condition, arrangement, and location that determines the degree of ease of ignition and the resistance to control (NWCG, 2003).

It is important to note that there is no possible single engineering metric capable of integrating all that must be considered with respect to fire hazard. Rather, it is necessarily a relative, dimensionless term. Unfortunately, the inherently relative nature of the term 'fire hazard' leads to the potential for more than one classification scheme, and for more than one application. For example, it is common to see the term used in the context of hazardous fuels.

Although there may be a variety of classifications for 'fire hazard', one element must be held constant—the term is independent of weather. That is, it applies only to the fuel itself, expressed for an instant or period of time, and does not include the weather or environs in which the fuel is distributed. The implications of this are not trivial. We know that to cause and sustain fire requires fuel, heat and oxygen; we also know that fire behavior is affected by fuel, weather, and topography. In either case, fuel is only one of three components required to predict or characterize fire. To further emphasize the exclusion of weather from the term 'fire hazard', Bachmann and Allgower (2000) also note the more exhaustive language used by the Ministry of Forests (MOF), Province of British Columbia (Canada) in their glossary of terms:

Fire hazard—the potential fire behavior for a fuel type, regardless of the fuel type's weather-influenced fuel moisture content ... Assessment is based on the physical fuel characteristics, such as fuel arrangement, fuel load, condition of herbaceous vegetation, and presence of elevated fuels (MOF, 1997).

The National Research Council (NRC) defines hazard in simplest form as ''an act or phenomenon with the potential to do harm'' (NRC, 1989). The critical phrase in this definition—''the potential to do harm''—implies that something else is needed (a causative agent) in order to convert the potential to realized harm. Put another way, in the case where no causative agent is possible, the potential for a pre-existing hazard to result in harm is nil. Similarly, the National Academy of Sciences (1983) addresses 'hazard' as ''events or conditions (both internal and external to the system) whose occurrence or existence might result in undesired consequences.'' I submit the following as a synthesis of the NWCG (2003) and Canadian (MOF, 1997) definitions for fire hazard:

A fuel complex, defined by volume, type, condition, arrangement, and location that determines the degree of ease of ignition and the resistance to control. Fire hazard expresses the potential fire behavior for a fuel type, regardless of the fuel type's weather-influenced fuel moisture content.

2.2. Fire risk

We typically define 'classic' on the basis of a legacy or heritage of use. This is particularly true with respect to the use of the term 'fire risk' within the fire management community. If the term 'fire risk' has a classic use, it derives from the first national, institutionalized decision-support system implemented in the U.S. fire community—the National Fire Danger Rating System (NFDRS) (Deeming et al., 1972). In the NFDRS, the occurrence of a spreading fire, or fire incidence, is literally termed ''fire risk''. Additionally, the NFDRS classifies two sources of fire risk: (1) lightning risk (LR); and (2) man-caused risk (MCR). In the case of LR, an index is determined on the basis of lightning activity experienced the previous day and expected for the current day, scaled by some probability of ignition. MCR is derived through inference from the relative level of human activity, the principal sources of human-caused ignitions, and other scalars. The two indices are each evaluated on a scale of 0–100, and when added together, they comprise total risk (also constrained to a maximum value of 100).

While this relative, dimensionless index (the NFDR 'total risk') is the sole, quantitative metric used in the U.S. to characterize 'fire risk', a more generalized definition of 'fire risk' has been commonly adopted by the fire community:

Fire risk—the chance that a fire might start, as affected by the nature and incidence of causative agents.

There is general agreement on this definition between numerous U.S. and international organizations, including the National Wildfire Coordinating Group (NWCG, 2003), the Society of American Foresters (1990, 1998), the Food and Agriculture Organization (FAO, 1986), and the Canadian Committee on Forest Fire Management (National Research Council Canada, 1987).

It is interesting to note that the word 'risk' has consistently been used in our society to express a negative construct. Even as the term 'risk' was adopted in the NFDRS nomenclature to express an ignition-probability index, we immediately attached an undesirable connotation to the ignition of any fire, anywhere. As discussed earlier, this negative connotation is yet another artifact of our societal legacy to presume (in this case, perhaps subconsciously) all fire as bad.

2.3. The ''other risks''

In the technical field of risk engineering, the term 'risk' is defined as the product of the probability of an event and the expected outcome—typically expressed as damage—of the event. If this engineering approach were to be applied to fire management, 'risk' would thereby be the product of the probability of a wildfire and the expected wildfire damages. Following this logic, Bachmann and Allgower (2000) have structured a wildfire risk model that incorporates not only the 'risk' terms of probability and outcome, but also the terms *wildfire occurrence*, *wildfire behavior*, and *wildfire effects*. So, when we hear the phrase ''risk of large, uncontrollable, catastrophic fire'', it is not difficult to connect the phrase to each component of the wildfire risk model—''risk of . . . fire'' connects to *wildfire occurrence*; ''uncontrollable'' connects to *wildfire behavior*; and ''catastrophic'' connects to *wildfire effects*. Unfortunately, this introduces several more layers of ambiguity to the language of fire management.

We can mitigate some of the ambiguity inherent in our use of the term 'risk' by more explicitly characterizing the process, resource, or value "at risk". As discussed earlier, 'fire risk' refers exclusively to the probability of a fire ignition. There are also dozens, if not hundreds, of other risks associated with fire for which assessments and management strategies might be applied. These risks incorporate not only the chance of fire, but also the expected value changes (damages), given a fire event. Sampson et al. (1998) have indexed (categorized) an extensive array of resource components—biotic habitat, sedimentation, air quality, people, ecosystem recovery—and their relative risks of change by extreme wildfire. Suter (1993) presents an entire volume on risk assessments in resource management.

2.4. Fire severity

Fire severity has been used all too casually to describe a milieu of fire-related characteristics, effects, and phenomenon. These have included flame length, fire size, resistance to control, rate of spread, fuel consumption, and others too numerous to list. In a paper on fire severity, Simard (1991) presented four definitional nuances on 'severity' taken from Webster's Seventh New Collegiate Dictionary (Gove, 1965):

1. Inflicting physical discomfort or hardship (harsh).
2. Inflicting pain or distress (grievous).
3. Requiring great effort (arduous).
4. Of a great degree (marked, serious).

Simard continues this line of reasoning by suggesting that, because the overall concept of severity is that of a strongly negative impact of one entity on another, 'fire severity' can therefore be defined as:

Fire severity—the magnitude of significant negative fire impacts on wildland systems (Simard, 1991).

It is imperative to note that this definition has nothing to do directly with the fire itself—not the fire's behavior, flame length, rate of spread, or any of the other measures of the fire. 'Fire severity' has everything to do with the effects of a fire on wildland systems.

In their development of spatial data on historical natural fire regimes for the conterminous United States, Hardy et al. (1998, 2001) define fire severity as "the intensity of the fire as it affects the bio-geo-chemical environment." Since the affected environment described by this definition includes flora and fauna—in other words, it refers to all wildland systems—the overall definition is very congruent with Simard's.

2.5. Characteristic or uncharacteristic fire

Despite many comments herein suggesting that our grasp and use of the language of fire lags far behind our technical and scientific understanding of fire, I am greatly encouraged by the rapid conversion from the use of 'catastrophic' to the use of 'uncharacteristic' when referring to fires having undesirable consequences. The title of the conference leading to this paper as well as the content of most of the other presentations and papers associated with the conference bear witness to this enlightened vision of how we characterize fire and its impacts on wildland systems.

The concept, "historical natural fire regime", provides a basis for assessing how uncharacteristic are the effects of a fire or potential fire(s). A fire regime refers to the process of fire as a disturbance agent, and there are numerous classifications of fire regime (Agee, 1993; Morgan et al., 2001; Hardy et al., 1998, 2001; Schmidt et al., 2002). Fire regimes describe historical fire conditions under which vegetation communities presumably evolved and were maintained (Hardy et al., 1998). The historical natural fire regime classification is not an exact reconstruction of historical conditions, defined here as conditions existing before extensive pre-Euro-American settlement, but rather reflect typical fire frequencies and effects that evolved without fire exclusion (Hardy et al., 1998).

Historical natural fire regimes range in frequency from very short return intervals ("frequent", 2–7 years), up to very long return intervals ("infrequent", >200 years). Effects range from low severity, non-lethal surface fires to extensive stand replacement crown fires involving all vertical and horizontal components of the fuel bed. This system for classifying fire as a natural disturbance process provides us with what we call a "biophysical baseline" against which current or expected occurrence events can be compared.

The concept provides an ecologically centric perspective for assessing fire effects; that is, it is deliberately designed to exclude from an assessment the social, economic, and cultural values that so often 'distort our memory'.

Now, a fire that occurs on a landscape for which we have knowledge of its historical natural fire regime can be assessed with respect to how closely it resembles the expected historical natural fire regime (again, in terms of fire frequency and effects). The greater the departure from historical natural fire regime, the more uncharacteristic is the fire. I note that even a stand replacement crown fire can be considered within the characteristic range of an historical natural fire regime. For example, Agee (1993) notes that fires in Pacific silver fir (*Abies amabilis*) forests are typically of high intensity, killing most or all of the trees. The historical natural fire regime for Pacific silver fir is characterized by infrequent fires of high severity (Agee, 1993). Similarly, although the stand-replacing crown fires that occurred in 1988 in Yellowstone National Park were dramatic and also damaged or threatened highly-valued cultural resources, they were characteristic of fires in the mixed- to high-severity fire regime for lodgepole pine (*Pinus contorta*) in the Greater Yellowstone Area.

3. On scale—time, space, and the processes therein

Having discussed the first two themes of this paper—problems of terminology, definitions—I address the third theme, the spatiotemporal context within which the terms hazard, risk, and severity are used. Scale includes both space and time, and must be explicitly addressed whenever we attempt to assess processes affecting hazard, risk, and severity. We can discuss the issues of scale using a model similar to the approach taken in ecological risk assessments, which are typically framed around well-defined ''end-points''. An assessment endpoint is a formal expression of the environmental values to be protected (Suter, 1993). Suter suggests five criteria that any endpoint should satisfy: (1) societal relevance; (2) biological relevance; (3) unambiguous operational definition; (4) accessibility to prediction and measurement; and (5) susceptibility to the hazardous agent (Suter, 1993). With respect to scale, Suter (1993) notes that spatiotemporal scales and organizational levels range from the very fine scale (organismal-level laboratory tests, expressed in hours to days), to the very coarse (environmental monitoring, requiring multiple years).

In discussing scale, Simard (1991) refers to fire's impacts on wildland systems. He then lists five wildland systems of interest:

1. Ecosystems (flora and fauna).
2. Geosystems.
3. Atmosphere.
4. Fire management.
5. Society.

For purposes of this discussion, these five wildland systems will be our assessment endpoints. Each of these wildland systems bears a distinctly different suite of attributes and values, and the potential effects of fire on these values are highly dependent on the scales of the wildland system(s) and of the wildland fire.

Simard (1991) provides an elegant time and space continuum that enables us to address the implications of scale when considering certain aspects of fire—especially hazard, risk, and severity—in the context of these five wildland systems (Fig. 1). The scale continuum in Fig. 1 is framed by three primary axes: *space* (the *x*-axis), ranging from a point (10^{-14} km^2) to the planet (5×10^7 km^2); *time* (the *y*-axis), ranging from the instant (second) to long term (century); and *process* (the diagonal), ranging from micro to global.

We can now use Simard's continuum to illustrate the potential range of scales over which a wildland fire might impact or influence each of the five wildland systems. Consider, for example, the Black Mountain 2 Fire that occurred during August of 2003 in the northern Rockies, immediately adjacent to Missoula, Montana. The potential ranges of influence of the Black Mountain 2 Fire for the five wildland systems are listed in Table 1 on scales of space and time. The fire affected *ecosystem* properties at individual spots as well as over the entire 30 km^2 extent of the fire, with the duration of various effects ranging from short term (days) to long term (many years). The fire influenced *geosystems* over areas ranging from a site (a hillside) to an area (a sub-watershed), with the duration of

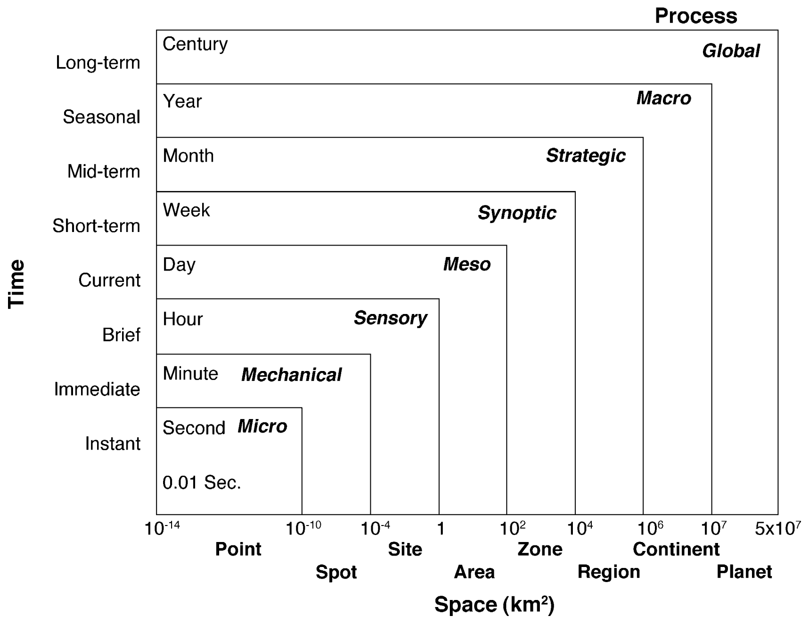

Fig. 1. The time and space continuum presented by Simard (1991) to illustrate the spatiotemporal context for eight process levels.

effects ranging from current (a day) to long term (many years). *Atmosphere* was affected at individual sites for brief periods, but long-range smoke dispersion reached nearly a continental extent for several periods over 2–3 weeks. *Fire management* impacts ranged from brief, local initial attack actions to national-level resource allocations over multiple seasons. *Societal* impacts ranged from brief road closures to near-continental scale impacts on air quality as well as the potential for significant interruptions to the regional electric power distribution grid. Clearly, the federal budget impacts from even this single, sixteen million dollar (US) event extend into one or more future budget years.

Table 1
The potential spatial and temporal ranges of influence of a fire on Simard's (1991) five wildland systems

Wildland system	Potential ranges of influence			
	Space domain		Time domain	
	Smallest	Largest	Shortest	Longest
Ecosystem	Spot	Area	Short term	Long term
Geosystem	Site	Area	Current	Long term
Atmosphere	Site	Continent	Brief	Mid term
Fire management	Spot	Region	Brief	Seasonal
Society	Spot	Continent	Brief	Seasonal

The principal objective of this example is to illustrate the range of temporal and spatial scales over which the attributes of a single fire must be considered, particularly with respect to the terminology we use. For this example, the spatial and temporal minima and maxima for the five wildland systems (from Table 1) are shown in Fig. 2, in which the overall minimum and maximum estimates for the Black Mountain 2 Fire are shown for space and for time by the dashed vertical and horizontal lines, respectively. How, for example, do we express the notions of hazard, risk, or severity for this fire when its ranges of spatial and temporal influence over the five wildland systems are so great?

4. Discussion

The theme of this volume, "*Risk assessment for decision-making related to uncharacteristic wildfire*", implies that some form of overall risk assessment or risk management strategy can be invoked for wildland fire. From the earlier discussion on 'fire risk' versus 'other risks', recall that the former refers only to the probability of an ignition. An assessment of any 'other risk' includes 'fire risk' (as a probability) as well as damages or value changes (impacts) to a resource or

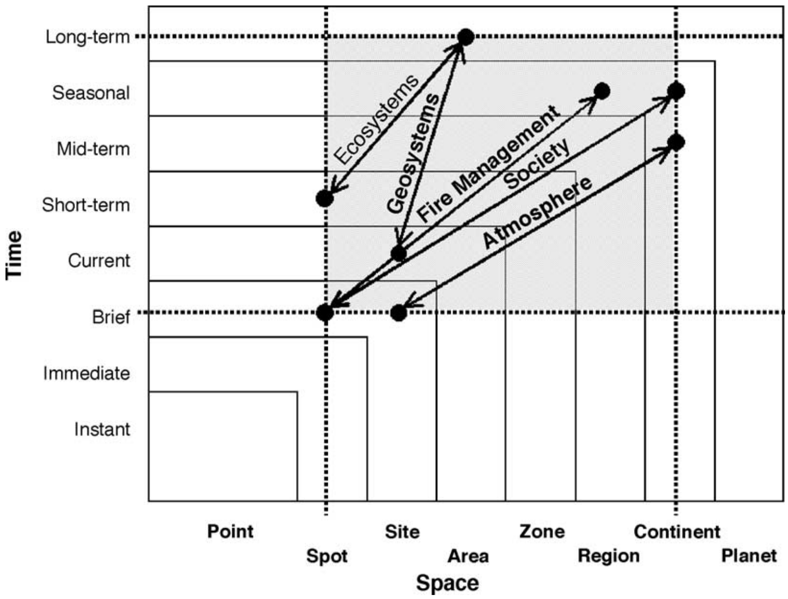

Fig. 2. The spatial and temporal domains of influence of a fire (Black Mountain 2 Fire, August 2003, western Montana) on *ecosystems*, *geosystems*, *atmosphere*, *fire management*, and *society*. The dashed vertical and horizontal lines indicate the ranges of influence for spatial and temporal domains, respectively.

entity (taken, perhaps, from one of the five wildland systems).

Using the Black Mountain 2 Fire as my example (Fig. 2), it is clear that spatial impacts extend from the site (*ecosystems*, *fire management*, *society*) to beyond the scale of a continent (*atmosphere*), and the temporal extent ranges from minutes (*ecosystems*, *fire management*) to a century (*geosystems*, *society*). The hazards, risks, and potential severity of wildland fire cannot be assessed, nor can a risk management strategy be formulated without strict, explicit definition of the temporal and spatial scales for which the strategy will be applied. The greater the range of time or space, the more generalized will be the assessment and strategy.

Exacerbating this cerebral problem is the instability of some endpoints with respect to currency and relevance. That is, our valuation of elements of wildland systems changes with time and over space. Suter's first criterion for identifying appropriate endpoints is social relevance (Suter, 1993). *Society* is the least stable of any of the endpoints presented here. Consider the implications to national-level resource management policies with changes in administrations in the federal Executive branch, or even under changes in majority leadership in the Congress. Suter uses the example of wetlands as an endpoint, contrasting the relevance of wetlands 20 years ago—not very relevant, little or no resource value, requiring linkages to other currently relevant endpoints such as fisheries and waterfowl—to the current independence and social importance of wetlands as a relevant endpoint in its own right (Suter, 1993). I suggest that the endpoint *fire management* is similarly susceptible to current policies and pressures, reminding us of Kierkegaard's advice to ''understand looking backwards'', versus our strong tendency to use the present to understand and explain the appropriate relevance and weight given to an endpoint.

The concept of historical natural fire regimes (Hardy et al., 1998, 2001; Morgan et al., 2001) has been exploited to create a classification based on departure from pre-settlement condition, called fire regime condition class (FRCC). The classification has as its basis the expected characteristic of potential current fire, contrasted with the characteristics of fire under natural conditions prior to Euro-American influences on the landscape. This has lead to the adoption of the term ''uncharacteristic wildfire'', which is the foundation element of the conference from which this volume was prepared. The notion of ''uncharacteristic'' versus ''characteristic'' wildfire is an attempt to control for the instability of socio-cultural valuations placed on the role, use, and management of wildland fire. In the context of FRCC, the 'other risk' is defined explicitly as *the risk of losing key ecological attributes that define an ecosystem*, given the occurrence of fire. This concept uses both components of risk assessment—occurrence of fire being ''fire risk'', and loss of key attributes being the change in values (damage).

5. Summary and conclusions

To facilitate the public understanding of the relative risks of fire, we must translate the language of fire and risk management into a clear and concise terminology. Although the history of fire and resource management is replete with definitions of fire terms (glossaries, dictionaries, manuals, user guides, policy documents), the recent tendency towards an all-risk approach has resulted in numerous ambiguities and inconsistencies in the use of most terms. Throughout history, we have examples where legitimately referenced terms have been obscured or replaced by emotional, value-driven interpretations. As a specific example discussed in this paper, 'catastrophic' derives from expressions of social, cultural, and economic value, and has no place in the fire management vernacular.

Fire management is not resource management; it is but one management activity. Management of natural resources must consider all activities (not just fire), and all wildland systems, characterized as ecosystems, geosystems, atmosphere, fire management, and society. We can assess the impacts of fire management strategies on all wildland systems through the concept of historical natural fire regimes—a biophysical baseline against which we compare potential or realized impacts. We can use the fire regime paradigm in a relative sense to help us assess how 'characteristic' or 'uncharacteristic' a fire (or potential fire) is.

In the business of fire management, the term 'fire risk' refers only to the chance (probability) of ignition of a spreading fire, and does not address values or damages. 'Hazard' is a fire-centric term, and is independent of weather. The term 'hazard' must only be used to express the state of the fuel complex. 'Severity' is a characterization of the effects of fire(s) on wildland systems, rather than of the fire itself. There are numerous concise terms used to describe fire and fire behavior; for example, flame length, rate of spread, fireline intensity—'severity' is not among these terms.

Even when appropriately applied, expressions of risk, hazard, and severity are highly scale-dependent. The relative importance of the individual endpoints within wildland systems changes with shifts in time and space. As Suter (1993) has asked, ''What exactly are we trying to protect, and to what extent should it be protected?'' Using the language of ecological risk assessment: for which endpoints do we manage for or mitigate risk, and what are the relative impacts of our management actions on other endpoints? And finally, we must learn to control, or at least correct for, the distortion of our memories caused by current, emotional events. We have much to learn by looking backwards, and much work to do living forward.

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