Fire and fuels management:
Definitions, ambiguous terminology and references

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Definitions related to fire and fuels management. Parentheses indicate the source of the definitions given in the reference section.

active crown fire: A crown fire in which the entire fuel complex becomes involved, but the crowning phase remains dependent on heat released from the surface fuels for continued spread (Scott and Reinhardt, 2001). Also called **running** and **continuous crown fire**.

appropriate management resource: Specific actions taken in response to a wildland fire to implement protection and fire use objectives (Firewise, 1998).

available canopy fuel: The mass of canopy fuel per unit area consumed in a crown fire. There is no post-frontal combustion in canopy fuels, so only fine canopy fuels are consumed. We assume that only the foliage and a small fraction of the branchwood is available (Scott and Reinhardt, 2001).

available fuel: The total mass of ground, surface and canopy fuel per unit area consumed by a fire, including fuels consumed in postfrontal combustion of duff, organic soils, and large woody fuels (Scott and Reinhardt, 2001).

biomass: Organic material. Also refers to the weight of organic material (e. g. roots, branches, needles, and leaves) within a given ecosystem (NFP).

backing fire: Fire that is moving into the wind (SKCMP).

backfiring: Intentionally setting fire to fuels inside a control line to contain a fire (SKCMP). See heading and flanking fire.

blackline: Refers to fuels that have burned, either intentionally or not. Many prescribed fire and wildfire suppression techniques are based on the concept of blackline as a barrier to fire spread (SKCMP).

burn severity, depth of burn, ground char: A measure of the amount of fuel consumption and associated heating at and below the ground surface. It is a function of the duration of the fire, and relates closely to the amount of surface fuel, litter and duff consumption, and their moisture content. Ground char is a qualitative measure of a fire's heat pulse downward into the soil. It is determined by visually judging the extent of fuel consumption, charring, and changes in soil texture (Robichaud, 2000). See also fire severity.

canopy density: The vertical projection of the tree canopy onto an imaginary horizontal surface representing the ground surface. Canopy density represents the amount of skylight that is intercepted before it strikes the forest floor, and it is usually given as a percentage of the total sky visible, and for this project understood to refer to coniferous trees unless explicitly noted as deciduous.

canopy base height: The lowest height above the ground at which there is a sufficient amount of canopy fuel to propagate fire vertically into the canopy. Canopy base height is an effective value that incorporates ladder fuels such as shrubs and understory trees (Scott and Reinhardt, 2001). See also **fuel strata gap** and **crown base height**.

canopy bulk density: The mass of available canopy fuel per unit canopy volume. It is a bulk property of a stand, not an individual tree (Scott and Reinhardt, 2001).

canopy fuels: The live and dead foliage, live and dead branches, and lichen of trees and tall shrubs that lie above the surface fuels (Scott and Reinhardt, 2001). See also **available canopy fuel**.

catastrophic fire: Catastrophic fire can be defined from three different perspectives: economic (the cost of damage), social (how it is viewed by the public), and ecological (biological effects of the fire) (Carey and Schumann, 2003). Covington and Moore (1994) defined catastrophic fire as a fire that kills a majority of the trees in the canopy in the ponderosa pine type or in any dry forest that was, in presettlement times, subject to frequent surface fires.

chain: A traditional forestry term equal to 66' or approximately 20 m (SKCMP).

cohort: Groups of trees with similar establishment times (Everett et al., 1999).

conditional surface fire: A potential type of fire in which conditions for sustained active crown fire spread are met but conditions for crown fire initiation are not. If the fire begins as a surface fire then it is expected to remain so. If it begins as an active crown fire in an adjacent stand, then it may continue to spread as an active crown fire (Scott and Reinhardt, 2001).

confine: Use of tactical actions to manage a fire within a predetermined area or perimeter, usually defined by geographic features. This term no longer has a strategic meaning in Federal wildland fire policy (USFS-R3).

contain: A tactical point at which a fire's spread is stopped by and within specific features, constructed or natural; also, the result of stopping a fire's spread so that no further spread is expected under foreseeable conditions. For reporting purposes, the time and date of containment. This term no longer has a strategic meaning in Federal wildland fire policy (USFS-R3).

continuous crown fire: See **active crown fire**.

control: To construct fireline, or use natural features to surround a fire and any spot fires therefrom and reduce its burning potential to a point that it no longer threatens further spread or resource damage under foreseeable conditions. For reporting purposes, the time and date of control. This term no longer has a strategic meaning in Federal wildland fire policy (USFS-R3).

cover type: The type of vegetation (or lack of it) growing on an area, based on minimum and maximum percent cover of the dominant species, species group or non-living land cover (such as water, rock, etc.). The cover type defines both a qualitative aspect (the dominant cover type) as well as a quantitative aspect (the abundance of the predominant features of that cover type).

creeping fire: A low intensity fire with a negligible rate of spread (SKCMP).

crown base height: The vertical distance from the ground to the bottom of the live crown of an individual tree (Scott and Reinhardt, 2001). See also **canopy base height**.

crown bulk density: The mass of available fuel per unit crown volume. Scott considers this a property of individual trees, not a whole stand (Scott and Reinhardt, 2001). See also **canopy bulk density**.

crown fire: Fire that has ascended from the ground into the forest canopy (SKCMP).

crown fire cessation: The process by which a crown fire ceases, resulting in a surface fire. Crown fire cessation is a different mechanism than crown fire initiation, possibly leading to hysteresis (Scott and Reinhardt, 2001).

crown fire hazard: A physical situation (fuels, weather, and topography) with potential for causing harm or damage as a result of crown fire (Scott and Reinhardt, 2001).

crowning index: The open (6.1-m) windspeed at which active crown fire is possible for the specified fire environment (Scott and Reinhardt, 2001).

entrapment: An entrapment is a situation where personnel are unexpectedly caught in a fire behavior related, life threatening position where planned escape routes or safety zones are absent, inadequate, or have been compromised. An entrapment may or may not include deployment of a fire shelter for its intended purpose (NWCG, 1995).

environmental conditions: That part of the fire environment that undergoes short-term changes: weather, which is most commonly manifest as windspeed, and dead fuel moisture content (Scott and Reinhardt, 2001).

fire analysis: No longer used, see (Firewise, 1998).

fire behavior - crown fires: These burn in the crowns of trees and shrubs usually ignited by a surface fire. They are common in coniferous forests and chaparral type shrublands (Paysen et al., 2000). Note that in a grassland with no trees and shrubs, a grass fire would technically be considered a stand-replacement crown fire, and depending on the type of grass and fire, the severity can range from low to high.

fire behavior - ground fires (Paysen et al., 2000): These burn in the organic material below the litter layer mostly by smoldering combustion. Fires in duff, peat, dead moss and lichens, and punky wood are typically ground fires (Paysen et al., 2000).

fire behavior - surface fires: These fires burn in litter and other live and dead fuels at or near the surface of the ground mostly by flaming combustion (Paysen et al., 2000).

fire behavior - total heat release: The heat released by combustion during burnout of all fuels in BTU per square foot or kilocalories per square meter (Paysen et al., 2000).

fire cycle: (1) A fire-return interval calculated using a negative exponential (or Weibull) distribution, applied using current age-class structure on the landcape; (2) Length of time required to burn an area equal in size to a specified area (SKCMP).

fire duration: The length of time that combustion occurs at a given point. It relates closely to downward heating and fire effects below the fuel surface as well as heating of tree boles above the surface (Paysen et al., 2000).

fire environment: The characteristics of a site that influence fire behavior. In fire modeling the fire environment is described by surface and canopy fuel characteristics, windspeed and direction, relative humidity, and slope steepness (Scott and Reinhardt, 2001).

fire frequency: A general term referring to the recurrence of fire in a given area over time. It is sometimes stated as number of fires per unit time in a designated area. It is also used to refer to the probability of an element burning per unit time (Johnson, 1992).

fire hazard (potential): The difficulty of controlling potential wildfire. It is commonly determined by fire behavior characteristics such as rate-of-spread, intensity, torching, crowning, spotting, and fire persistence, and by resistance-to-control. It may be partitioned into particular components such as *crown-fire* hazard. Carey and Schumann (2003) document that fire hazard reduction is a continual process that cannot be accomplished by a single prescribed fire, or by analogy, thinning treatment (Brown et al., 2003). A physical situation (fuels, weather, and topography) with potential for causing harm or damage as a result of wildland fire (Scott and Reinhardt, 2001).

fire intensity: See **frontal fire intensity**. Contrast with **fireline intensity**.

fire management plan: A strategic plan that defines a program to manage wildland and prescribed fires and documents the Fire Management Program in the approved land use plan. The plan is supplemented by operational procedures such as preparedness plans, preplanned dispatch plans, prescribed fire plans, and prevention plans (Firewise, 1998).

fire regime: The combination of fire frequency, predictability, intensity, seasonality, and size characteristics of fire in a particular ecosystem (SKCMP). Disturbance regimes are used to characterize the spatial scale and temporal patterns of disturbance and subsequent response and recovery of ecosystems (Averill et al., 1995). An integration of disturbance attributes including type, frequency, intensity, duration, and extent (Chelan RD, 2003). Classifications of fire regimes can be based on the characteristics of the fire itself or on the effects produced by the fire (Agee 1993).

fire regime condition class: Condition classes are a function of the degree of departure from historical fire regimes resulting in alterations of key ecosystem components such as composition structural stage, stand age, and canopy closure (Chelan RD, 2003).

fire risk: This is not well defined. Dan Bailey, Fire Management Officer of the Lolo National Forest, and a leader of the national wildfire-preparedness program, said this of the FY 2000 National Fireplan Funding, “there was no common definition of what constituted a “community at risk.” (Devlin, 2002). The GAO (2003) report on fuel reduction prioritization, excerpting from a USDA-USDI report, claim that the highest levels of fuels buildup correspond to the highest wildfire risk ranking, as follows: (1) High Risk areas are those at risk of damage to soil, vegetation, and water quality from fire; (2) Moderate Risk areas are those with moderate levels of fuels buildup where the role of fire in the ecosystem has been altered, allowing fires to occur less frequently than they did historically; (3) Low Risk areas are those with fire occurrences at frequencies and severities similar to historical patterns. Mark Morris (2000) states, “Fire risk pertains to sources of or causative agents for wildfires. Risk deals with the likelihood or probability of an ignition source. Examples of sources and causative agents include: lightning, equipment use, smoking, campfires, debris burning, railroads and power lines, incendiary or arson and children. … Our Fire Prevention programs comprise our efforts to educate the public and minimize fire risk.”

fire return interval: The arithmetic mean of all fire intervals in a given area over a given time period (Romme, 1980).

fire rotation: The length of time necessary for an area equal in size to the study area to burn and is equal to the fire cycle (Romme, 1980).

fire severity: A qualitative measure of the immediate effects of fire on the ecosystem. It relates to the extent of mortality and survival of plant and animal life both aboveground and belowground and to loss of organic matter. It is determined by heat released aboveground and belowground (Paysen et al., 2000). The effect of fire on plants (SKCMP). It is dependant on intensity and residence dependant of the burn. For trees, severity is often measured as percentage of basal area removed. An intense fire may not necessarily be severe. See also burn severity.

fire shelter deployment: The removing of the fire shelter from its case and using it properly for protection against fire (NWCG, 1995).

fire spreading rate: Fire spreading rate relates to velocity, measured by a unit of distance per unit of time (Carey and Schumann, 2003).

fire type: Refers to the fuels that are primarily supporting the fire namely surface fires, ground fires, and crown fires (Paysen et al., 2000).

fireline intensity: Also called Byram's intensity, this is the rate of energy release per unit length of the fire front expressed as BTU per foot of fireline per second or as kilowatts per meter of fireline (Paysen et al., 2000). This is a physical parameter that is related to flame length. This expression is commonly used to describe the power of wildland fires, but it does not necessarily follow that the severity, defined as the vegetation mortality, will be correspondingly high (Carey and Schumann, 2003).

flame length: The length of flames in the propagating fire front measured along the slant of the flame from the midpoint of its base to its tip. It is mathematically related to fireline intensity and tree crown scorch height (Paysen et al., 2000).

flanking fire: Fire that is moving perpendicular to the wind (SKCMP). See heading and backing fire.

flaming front: The zone at a fire's edge where solid flame is maintained (Scott and Reinhardt, 2001).

foliar moisture content: Moisture content (dry weight basis) of live foliage, expressed as a percent. Effective foliar moisture content incorporates the moisture content of other canopy fuels such as lichen, dead foliage, and live and dead branchwood (Scott and Reinhardt, 2001).

foliar moisture effect: A theoretical effect of foliar moisture content on active crown fire spread rate (Van Wagner 1974, 1979, 1993).

frontal fire intensity: Similar to fireline intensity, it is the rate of heat release per unit length of fire front, including the additional heat released from postfrontal flaming and smoldering combustion (Forestry Canada Fire Danger Group 1992).

fuel - available fuel: The amount of biomass that will burn under a given set of conditions. Moisture content and fuel size are the primary determinants of availability. Arrangement and compactness of fuel may also determine availability (Paysen et al., 2000).

fuel complex: The combination of ground, surface, and canopy fuel strata (Scott and Reinhardt, 2001).

fuel continuity: A qualitative description of the distribution of fuel both horizontally and vertically. Continuous fuels readily support fire spread. The larger the fuel discontinuity, the greater the fire intensity required for fire spread (Paysen et al., 2000).

fuel loading: The weight per unit area of fuel often expressed in tons per acre or tonnes per hectare. Dead woody fuel loadings are commonly described for small material in diameter classes of 0 to 0.25, 0.25 to 1, and 1 to 3 inches and for large material greater than 3 inches (Paysen et al., 2000).

fuel model: A set of surface fuel bed characteristics (load and surface-area-to-volume-ratio by size class, heat content, and depth) organized for input to a fire model. Standard fuel models (Anderson 1982) have been stylized to represent specific fuel conditions (Scott and Reinhardt, 2001).

fuel moisture content: This is expressed as a percent or fraction of oven dry weight of fuel. It is the most important fuel property controlling flammability. In living plants it is physiologically bound. Its daily fluctuations vary considerably by species but are usually above 80 to 100 percent. As plants mature, moisture content decreases. When herbaceous plants cure, their moisture content responds as dead fuel moisture content, which fluctuates according to changes in temperature, humidity, and precipitation (Paysen et al., 2000).

fuel strata gap: The vertical distance between the top of the surface fuel stratum and the bottom of the canopy fuel stratum (Scott and Reinhardt, 2001).

fuel stratum: A horizontal layer of fuels of similar general characteristics. Three fuel strata are recognized: ground, surface, and canopy (Scott and Reinhardt, 2001).

full-range fire behavior simulation: The simulated behavior of a wildland fire whether it is a surface fire, passive crown fire, or active crown fire. Ground fire behavior is usually not included (Scott and Reinhardt, 2001).

fuel - total fuel: The amount of biomass that potentially could burn (Paysen et al., 2000).

fuel treatments: Any measurable procedure to reduce the amount of hazardous fuel in an ecosystem (NFP).

ground fire (or surface fire): Fire burning on the ground or through the understory and not reaching into the canopy (SKCMP). A slow-burning, smoldering fire in ground fuels (Scott and Reinhardt, 2001). Contrast with **surface fire**.

gound fuels: Fuels that lie beneath surface fuels, such as organic soils, duff, decomposing litter, buried logs, roots, and the below-surface portion of stumps (Scott and Reinhardt, 2001). Compare with **surface fuels**.

hazardous fuels reduction: Any strategy that reduces the amount of flammable material in a fire- prone ecosystem. Two common strategies are mechanical thinning and controlled burning. Hazardous fuels reduction is a significant element of the National Fire Plan (NFP).

heading fire: Fire that is moving with the wind (SKCMP). See backing and flanking fire.

hysteresis: The failure of a property that has been changed by an external agent to return to its original value when the cause of the change is removed. In crown fire, hysteresis is expressed in the persistence of active crowning after the fire environment has changed such that a crown fire could no longer initiate (Scott and Reinhardt, 2001).

incident: An occurrence or event, either natural or person-caused, which requires an emergency response to prevent loss of life or damage to property or natural resources (USFS-R3).

incident commander: The individual responsible for direct management of all incident operations; the leader of an incident command team (USFS-R3).

independent crown fire: A **crown fire** that spreads without the aid of a supporting surface fire (Scott and Reinhardt, 2001).

initial attack: An aggressive suppression action consistent with firefighter and public safety and values to be protected. These are the actions taken by the first resources to arrive at a wildfire to protect lives and property, and prevent further extension of the fire (WPFMP, 1998).

intermittent crown fire: A crown fire that alternates in space and time between active crowning and surface fire or passive crowning (Scott and Reinhardt, 2001). See also passive crown fire.

ladder fuels: Fuels, such as branches, shrubs or an understory layer of trees, which allow a fire to spread from the ground to the canopy (SKCMP).

line officer: Same as agency administrator; the official responsible for administering policy on an area of public owned land and having full authority for making decisions and providing direction to the incident management organization (USFS-R3).

mass-flow rate: The rate of fuel consumption (kg m^{-2} s^{-1}) through a vertical plane (oriented parallel with the fireline) within the fuel bed. It is the product of spread rate (m s^{-1}) and fuel bed bulk density (kg m^{-3}).

objective: A concise, time-specific statement of measurable, planned results that respond to preestablished goals. An objective forms the basis for further planning to define the steps to be taken and the resources to be used in achieving identified goals (USFS-R3).

passive crown fire: A crown fire in which individual or small groups of trees torch out, but solid flaming in the canopy cannot be maintained except for short periods. Passive crown fire encompasses a wide range of crown fire behavior from the occasional torching of an isolated tree to a nearly active crown fire. Also called torching and candling (Scott and Reinhardt, 2001). See also **intermittent crown fire**.

plume-dominated fire: A fire for which the power of the fire exceeds the power of the wind, leading to a tall convection column and atypical spread patterns (Scott and Reinhardt, 2001). Contrast with **wind-driven fire**.

prescribed fire: Any fire ignited by management actions to meet specific objectives. A written, approved prescribed fire plan must exist, and NEPA requirements must be met, prior to ignition (Firewise, 1998).

preparedness: Activities that lead to a safe, efficient, and cost- effective fire management program in support of land and resource management objectives through appropriate planning and coordination (WPFMP, 1998). Examples include: activities done in preparation for fire season such as, annual refresher training, work capacity testing, review of plans and guides as well as fire equipment and personnel readiness checks.

prescription: Measurable criteria which guide selection of appropriate management response and actions. Prescription criteria may include safety, economic, public health, environmental, geographic, administrative, social, or legal considerations (Firewise, 1998).

presuppression: No longer used, has been replaced by "preparedness" (Firewise, 1998).

reburn: Different viewpoints explain the observation of secondary burns that follow closely after an initial fire. (1) Reburn results when falldown of the old burned forest contributes significantly to the fire behavior and fire effects of the next fire (Brown et al., 2003). (2) Karr et al. (2002), quoting a report by Everett, remind the House of Representatives that slash from salvage is just as likely to produce reburn: "The Everett Report (p. 5) also states that current research suggests that salvage logged areas may have elevated fire hazard over unlogged sites for the first twenty years after logging." (3) The rapid release of previously suppressed understory growth and germination of new plants after a fire is also responsible for reburn, as noted by Everett et al. (1999): "once a vegetation type has been created that burns more readily than previous plant assemblages, the probability for reburn is increased." (4) Paysen et al (2000) added that this can occur from needle drop as well as woody debris: "Postburn accumulation of fuel is rapid as most grasses, shrubs, and palmetto resprout within a week of the burn regardless of the season."

running crown fire: See **active crown fire**.

site characteristics: The characteristics of a location that do not change with time: slope, aspect, elevation (Scott and Reinhardt, 2001).

spot fire: A smaller fire that has started from sparks and brands thrown in the air by the main fire (SKCMP).

strategy: A plan or direction selected through a decision making process to guide wildland fire management actions to meet protection and fire use objectives (USFS-R3).

suppression: A management action intended to extinguish a fire or alter its direction of spread (USFS-R3).

surface fire: A fire burning along the surface without significant movement into the understory or overstory, with flame length usually below 1 m (SKCMP).

surface fuels: Needles, leaves, grass, forbs, dead and down branches and boles, stumps, shrubs, and short trees (Scott and Reinhardt, 2001).

surfacing Index: The higher of O'_{active} and $O'_{cessation}$. The Surfacing Index is the open windspeed at which an active crown fire can be expected to drop to the surface, either due to insufficient mass-flow rate through the canopy or insufficient contribution of surface fuels to fireline intensity (Scott and Reinhardt, 2001).

tactics: Specific actions employed to implement and achieve objectives set forth by the chosen strategy (USFS-R3).

timelag class: A method of categorizing fuels by the rate at which they are capable of moisture gain or loss, indexed by size class (SKCMP).

torching fire: Fire burning principally as a surface fire that intermittently ignites the crowns of trees or shrubs as it advances (SKCMP).

torching Index: The open (6.1-m) windspeed at which crown fire activity can initiate for the specified fire environment (Scott and Reinhardt, 2001).

total biomass: The mass per unit area of all living and dead vegetation at a site (Scott and Reinhardt, 2001).

total fuel load: The mass of fuel per unit area that could possibly be consumed in a hypothetical fire of the highest intensity in the driest fuels (Scott and Reinhardt, 2001).

type: A classification of resources in the incident command system which refers to capability. Type 1 is generally considered to be more capable than Types 2, 3, or 4, respectively, due to size, power, capacity, or in the case of incident management teams, experience and qualifications (USFS-R3).

transition: Transition to the next level of fire management is expected and required when it becomes apparent that the assigned resources will not meet containment objectives in the expected time frames and/ or the fire escalates to another level of complexity (NWCG).

understory fire: A fire burning in the understory, more intense than a surface fire with flame lengths of 1-3 m (SKCMP).

values to be protected, or **values at risk**: A relative estimate, or known measure of worth of resources and property exposed to a chance of loss or damage from wildland fire; those resources or property specified, e.g. watershed, air quality, timber production, wildlife habitat (USFS-R3).

wildland fire: Any non-structure fire , other than prescribed fire, that occurs in the wildland (Firewise, 1998).

wildland fire situation analysis (WFSA): A decision-making process that evaluates alternative management strategies against selected safety, environmental, social, economical, political, and resource management objectives as selection criteria (Firewise, 1998).

wildland-urban interface (WUI): Zone where structures and other human developments meet, or intermingle with, undeveloped wildlands (SKCNP). The [WUI] fire interface is any point where the fuel feeding a wildfire changes from natural (wildland) fuel to man-made (urban) fuel. ...For this to happen, wildland fire must be close enough for its flying brands or flames to contact the flammable parts of the structure (Butler, 1974, p. 3). The WUI has been variously defined as any area designated by the agencies that includes an interface/intermix community. The Inslee Amendment to a U.S. House of Representatives Bills for expediting fuel reduction projects defined the wildland-urban interface as limited to land in high fire-risk areas within ½ mile of communities. The McInnis-Miller Amendment to these House bills regarding fuel reduction projects does not include a distance limitation. Speaking at a public lecture fire researcher Jack Cohen said that often the radiant heat from a fire, not the fire itself, will ignite a home or other structure. This “ignitability zone” lies within 100 feet of the house. Cohen also addressed crown fires and demonstrated that crown fires did not ignite homes and urban structures at distances greater than 65 feet, which means that home ignitions from flames occur within distances of about 30 to 40 feet (Colonna, 2000).

wind-driven fire: A wildland fire in which the power of the wind exceeds the power of the fire, characterized by a bent-over smoke plume and a high length-to-width ratio (Scott and Reinhardt, 2001).

wind reduction factor: The ratio of the midflame windspeed to the open (6.1-m) windspeed. For convenience of measurement eye-level winds are usually substituted for midflame winds (Scott and Reinhardt, 2001).

Ambiguous terminology: citation and discussion

Note: emphasis has been added to highlight key points.

Ambiguous terminology related to "fire hazard"

The 2003 GAO report states (introduction):

> The Forest Service and Interior have identified three categories of land for fuels reduction: (1) lands with excess fuels buildup, (2) lands in the wildland-urban interface where federal lands surround or are adjacent to urban development and communities, and (3) lands where vegetation grows rapidly and requires regular maintenance treatments to prevent excess fuels buildup.

The 2003 GAO report states (p. 3):

> Government scientists have collected nationwide data on lands with excess fuels buildup, but because the data were not detailed, there was a large margin of error in the resulting estimates. Recognizing the need for more accurate estimates, the agencies are currently considering whether to fund a project to assess in more detail the fuels buildup on federal land nationwide. If funded, they do not expect to complete the effort until 2008 at the earliest.

Carey and Schumann (2003) cite the following in their conclusion:

> *Although the assertion is frequently made that reducing tree density can reduce wildfire hazard, the scientific literature provides tenuous support for this hypothesis.*
>
> ... Deeming (1990), suggested, "*we do not know whether proposed treatments will be effective in reducing the size, intensity, or severity of wildfires.*"
>
> ... A report prepared for Congress stated: "*We do not presume that there is a broad scientific consensus surrounding appropriate methods or techniques for dealing with fuel build-up or agreement on the size of areas where, and the time frames when, such methods or techniques should be applied.*" (US GAO 1999:56).
>
> ... A research report by Omi and Martinson (2002:1) stated: "*Evidence of fuel treatment efficacy for reducing wildfire damages is largely restricted to anecdotal observations and simulations.*"
>
> ... Jim McIver, a research scientist undertaking a five year study of alternative fuel treatment strategies stated: "*At this point, information needed to answer this question is anecdotal or completely absent.*" (Sonner 2002).
>
> Given the lack of scientific research, it is not surprising that forest managers also appear to lack adequate information concerning appropriate fuel reduction treatments. In a letter, a regional forest manager stated: "*Regarding your question about different thinning prescriptions demonstrating relative effectiveness in reducing the intensity of spread of*

crown fire, I don't know of any [studies]." (Personal Communication 2000).

In sum, the notion that mechanical thinning, or a combination of thinning and prescribed fire, reduces the incidence of catastrophic fire needs to be viewed as a working hypothesis and needs to be tested through experimentation and site-specific evidence. The proposal that commercial logging can reduce the incidence of canopy fire appears completely untested in the scientific literature.

Mark Morris, Ranger, Tonasket RD, USFS (letter of Aug 23, 2000) writes,

> [F]ire hazard reduction is the planned treatment or manipulation of naturally growing vegetation or any other flammable material for the purpose of reducing fire intensity and the output of heat energy from any wildfire occurring in the area treated. In layman's terms, *Forest Service efforts to reduce fire hazard comprise our efforts to avoid very severe (lethal-intensity) fires that are tremendously difficult to control and to increase our options to use wildland fire in a beneficial way*."

The Thirtymile Fire Final Report (USDA, 2001), which had a thorough investigation following four fatalities, has this chart that describes fire hazards on page 54 (but note that the legend below the table is unfinished making it unclear whether the chart is equating ignition likelihood with hazard or not):

Fire Behavior Figure 1. Fireline Handbook Table 13 and the Relation to the Phases of the Thirtymile Fire Phases

	Relative Humidity	Fuel Moisture 1-Hour	Fuel Moisture 10-hour	Relative ease of chance ignition and spotting, general burning conditions
	>60	>20	>15	Very little ignition; some spotting may occur with winds above 9mi/h.
Initial Phase	45 - 60	15-19	12-15	Low ignition hazard - campfires become dangerous; glowing bands cause ignition when relative humidity is < 50%
Initial Phase	30 -45	11 -14	10-12	Medium ignition hazard - matches become dangerous; "easy" burning conditions.
Initial Phase	26-40	8 -10	8-9	High ignition hazard; matches are dangerous; occasional crowning; spotting caused by gusty winds; "moderate" burning conditions.
Transition, Entrapment, and Deployment Phases	15-30	5-7	5-7	Quick ignition, rapid buildup, extensive crowning; any increase in winds causes an increased spotting, crowning, loss of control; fire moves up bark of trees igniting aerial fuels; long distance spotting in pine stands; dangerous burning conditions.
Transition, Entrapment, and Deployment Phases	< 15	< 5	< 5	All sources of ignition dangerous; aggressive burning, spot fires occur often and spread rapidly; extreme fire behavior probable; critical burning conditions.

Table 13 in the Fireline Handbook (NWCG Handbook 3 January 1998) displays the expected

Ambiguous terminology related to "fire regime"

Brown and Smith (2000) reviewed two recent fire regime classifications, that of Morgan and others (1998), who mapped historical and current fire regimes in the Interior Columbia River Basin based on four fire severity and five fire frequency classes, and that of. Hardy and others (1998) who mapped fire regimes of the Western United States using fire severity and fire frequency combined into five classes. The latter study keyed the fire regime classes to spectral images and biophysical data including elevation, hydrologic units, Kuchler's vegetation types, and Bailey's (1995) sections. Results are summarized in the following chart used to prioritize allocation of funds:

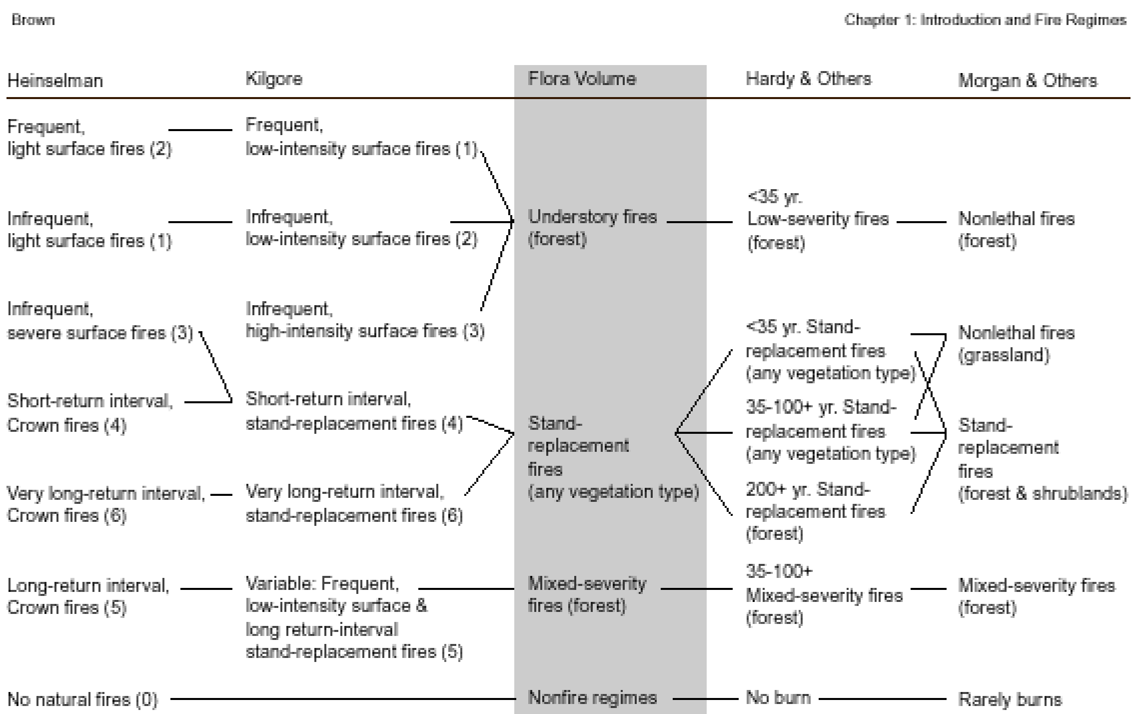

Figure 1-1—Comparison of fire regime classifications by Heinselman (1978), Kilgore (1981), Hardy and others (1998), Morgan and others (1998), and the Flora and Fuel Volume. Lines connect similar fire regime types. In parentheses, forest includes woodlands and grassland includes shrublands.

Brown and Smith (2000) used the following definitions of fire regime types in their Flora and Fuel Monograph, which uses a fire regime classification similar to that reported by Morgan and others (1998):

1. Understory fire regime (applies to forests and woodlands) Fires are generally nonlethal to the dominant vegetation and do not substantially change the structure of the dominant vegetation. Approximately 80 percent or more of the aboveground dominant vegetation survives fires.
2. Stand-replacement fire regime (applies to forests, woodlands, shrublands, and grasslands) Fires kill aboveground parts of the

dominant vegetation, changing the aboveground structure substantially. Approximately 80 percent or more of the aboveground dominant vegetation is either consumed or dies as a result of fires.
3. Mixed severity fire regime (applies to forests and woodlands) Severity of fire either causes selective mortality in dominant vegetation, depending on different tree species' susceptibility to fire, or varies between understory and stand-replacement.
4. Nonfire regime with little or no occurrence of natural fire.

The understory and mixed severity fire regimes apply only to forest and woodland vegetation types. The mixed severity fire regime was described as arising in three ways:

1. Many trees are killed by mostly surface fire but many survive, usually of fire resistant species and relatively large size. This type of fire regime was described as the "moderate severity" regime by Agee (1993) and Heyerdal (1997).
2. Severity within individual fires varies between understory burning and stand- replacement, which creates a fine- grained pattern of young and older trees. This kind of fire regime has not been recognized in previous classifications. It probably occurs because of fluctuations in weather during fires, diurnal changes in burning conditions, and variation in topography, fuels, and stand structure within burns (see chapters 5 and 6). Highly dissected terrain is conducive to this fire regime. In actuality, a blend of these two mixed severity types probably occurs.
3. Fire severity varies over time with individual fires alternating between understory burns and standreplacement. Kilgore (1987) described this as the "variable" regime and applied it to redwood forests. It also fits red pine forests (chapter 3).

Brown and Smith (2000) consider grasslands and tundra fire regimes to be essentially stand-replacement regimes because the aboveground dominant vegetation is either killed or removed by fire. They also consider many shrubland ecosystems to have stand-replacement fire regime types because the dominant shrub layer is usually killed back to growing points in or near the ground. Stand replacement fires in grass and sedge dominated ecosystems are considered as either lethal or nonlethal to aboveground vegetation depending on the fire behavior. It is nonlethal if vegetative parts have already cured and exist as dead fuel, which is often the case in Western United States. But it is lethal if some of the aboveground grasses and sedges are living and are killed by fire as is commonly the case in marshes of eastern North America and in tundra. Fire is usually nonlethal to belowground plant parts allowing species that sprout to recover rapidly.

Brown and Smith (2000) discussed the mixed fire regimes of Douglas-fir, western larch, and Rocky Mountain lodgepole pine. These occurred from central British Columbia (Strang and Parminter 1980) and Jasper National

Park, Alberta (Tande 1979), southward at least to western Wyoming (Arno 1981; Loope and Gruell 1973). They were abundant and diverse in western and central Montana (Arno 1980; Barrett and others 1991, Arno and Gruell 1983). Mixed fire regimes allowed an open overstory of mature Douglas-fir and larch to survive many fires. Small trees and associated less fire-resistant species were heavily thinned by moderate-intensity burning. Additionally, some nonlethal underburns occurred in lodgepole pine stands having light fuels. Occasional stand-replacing fires were also part of the mixture making up this fire regime. Effects of these variable fires often included maintaining a fine grained forest community mosaic on much of the landscape.

Brown and Smith (2000) also discussed ponderosa pine fire regimes:

> Some ponderosa pine forests were historically characterized by mixed fire regimes, although the extent and ecological relationships of these mixed regimes are yet to be determined. It appears that mixed regimes were commonly associated with ponderosa pine growing east of the Continental Divide, and also with some forests west of the Divide, especially those on steep slopes and on relatively moist sites. The most compelling evidence for a large area of mixed fire regime comes from the Black Hills of South Dakota (Brown and Sieg 1996; Gartner and Thompson 1973; Shinneman and Baker 1997) and the Front Range of the Rocky Mountains in Colorado (Kaufmann 1998; Laven and others 1980). Many of the ponderosa pine stands in the Black Hills and nearby areas of northeastern Wyoming and southeastern Montana develop dense patches of pine regeneration after fire, which become thickets of small stagnant trees, susceptible to stand-replacing fire. Intervening areas with more open stocking presumably were more likely to underburn in the frequent fires of the presettlement era. Factors contributing to a mixed fire regime in ponderosa pine probably include relatively moist sites that tended to produce pine thickets soon after a fire, areas frequently exposed to high winds during the burning season, steep topography, and stands killed by bark beetle epidemics.

Paysen et al. (2000) looked at fire regimes in shrub-steppe ecosystems. They correlated regimes based on the following charts.

Table 6-1—Occurrence and frequency of presettlement fire regime types by Forest and Range Environmental Study (FRES) ecosystems, Kuchler potential natur
classes (1975 map codes), and Society of American Foresters (SAF) cover types. Occurrence is an approximation of the proportion of a vegetation class
by a fire regime type. Frequency is shown as fire interval classes defined by Hardy and others (1998) followed by a range in fire intervals where data a
The range is based on study data with extreme values disregarded. The vegetation classifications are aligned to show equivalents; however, some co
Kuchler and SAF types may not be shown.

			Fire regime types					
			Understory		Mixed		Stand-replacement	
FRES	Kuchler	SAF	Occur[a]	Freq[b]	Occur	Freq	Occur	Freq
Ponderosa pine 21	SW ponderosa pine[c]	Interior ponderosa pine 237	M	1a:2-10	m	1		
	Arizona pine forest K019		M	1a:2-10	m	1		
	Pine-cypress forest K009	Arizona cypress 240			M	1,2	m	1
Pinyon-juniper 35	Juniper-pinyon K023	Rocky Mountain juniper 220			M	1		
	Juniper-steppe K024	Western juniper 238			M	1		
		Pinyon-juniper 239			M	1		
		Arizona cypress 240			M	1		
Southwestern oaks[d]	California oakwoods K030	Canyon live oak 249			M	1		
		California coast live oak 255			M	1		
		California black oak 246			M	1		
		Blue oak-digger pine 250	M	1	M	1		
	Oak-juniper K031	Interior live oak 241			M	1		
Shinnery 31	Shinnery K071	Mohrs oak 67			M	1		
Texas savanna 32	Ceniza shrub K045				M	1		
	Mesquite savanna K060	Mesquite 68, 242			M	1		
	Mesquite-acacia savanna K061				M	1		
	Mesquite-live oak savanna K062	Western live oak 241			M	1		
	Juniper-oak savanna K086	Ashe juniper 66			M	1		
	Mesquite-oak savanna K087				M	1		
Sagebrush 29	Sagebrush steppe K055						M	2a:20-7
	Juniper steppe K024	Rocky Mountain juniper 220					M	2a
	Great basin sagebrush K038	Western juniper 238					M	2a:20-7
	Wheatgrass-needlegrass shrubsteppe K056						M	2a
Desert shrub 30	Mesquite bosques K027	Mesquite 68, 242					M	1,2a
	Blackbrush K039						M	1,2a
	Saltbrush-greasewood K040						M	1,2a
	Creosotebush K041						M	1,2a
	Creosotebush-bursage K042						M	1,2a
	Paloverde-cactus shrub K043						M	1,2a
	Cresotebush-tarbush K044						M	1,2a
SW shrubsteppe 33	Grama-tobosa K058						M	1,2a
	Trans-pecos shrub savanna K059						M	1,2a
Chaparral-Mountain shrub 34	Oak-juniper woodland K031						M	1,2a

Table 6-1—Con.

			Fire regime types						
			Understory		Mixed		Stand-replacement		
FRES	Kuchler	SAF	Occur[a]	Freq[b]	Occur	Freq	Occur	Freq	Non
	Mountain mahogany-oak scrub K037						M	1,2a	
	Transition of K031 & K037						M	1,2a	
	Chaparral K033						M	1,2a	
	Montane chaparral K034						M	1,2a	
	Coastal sagebrush K035						M	1,2a	
Plains grasslands 38	Grama-needlegrass-wheatgrass K064						M	1	
	Grama-buffalograss K065						M	1	
	Wheatgrass-needlegrass K066						M	1	
	Wheatgrass-bluestem-needlegrass K067						M	1	
	Wheatgrass-grama-buffalograss K068						M	1	
	Bluestem-grama prairie K069						M	1	
	Mesquite-buffalograss K085	Mesquite 68, 242					M	1	
Desert grasslands 40	Grama-galleta steppe K053						M	1,2a	
	Grama-tobosa prairie K054						M	1,2a	
	Galleta-three-awn shrubsteppe K057						M	1,2a	
Annual grasslands 42	California steppe K048						M	1,2a	
Mountain grasslands 36	Fescue-oatgrass K047						M	1	
	Fescue-wheatgrass K050						M	1	
	Wheatgrass-bluegrass K051						M	1	
	Foothills prairie K063						M	1a	
	Cheatgrass [c]								

[a]M: major, occupies >25% of vegetation class; m: minor, occupies <25% of vegetation class
[b]Classes in years are 1: <35, 1a: <10, 1b: 10 to <35, 2: 35 to 200, 2a: 35 to <100, 2b: 100 to 200, 3: >200.
[c]This type was not defined by Kuchler.
[d]Added subdivision of FRES.

Pinyon-juniper was considered to have a mixed fire regime, however it was mapped to cover a greater extent than is currently accepted:

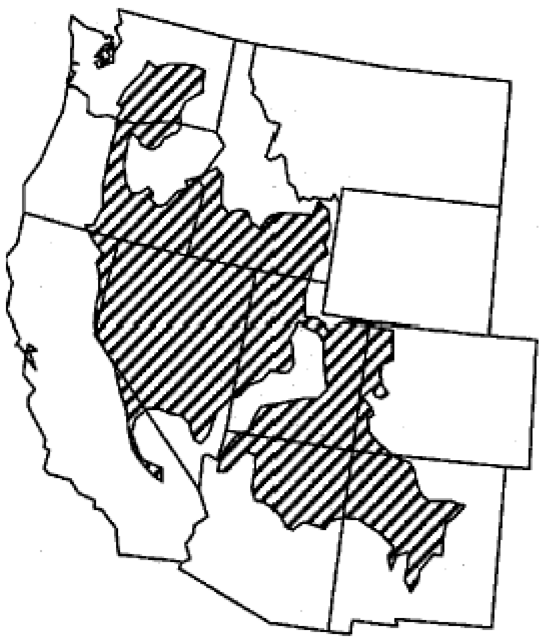

Figure 6-5—Pinyon-juniper woodlands distribution.

Paysen et al. (2000) note,

> In the Intermountain West, presettlement mean fire intervals of less than 15 years were documented in the sagebrush steppe where western juniper now dominates (Miller and Rose 1999).
>
> ... Despain and Mosley (1990), working in the pinyon-juniper and ponderosa pine ecotone at Walnut Canyon National Monument in Arizona, reported a surface fire interval of approximately 20 to 30 years. Other studies by C. Allen and by T. Swetnam and his associates (Gottfried and others 1995), on productive sites in New Mexico, indicated that standwide fires, which covered more than 25 acres, occurred at 15 to 20 year intervals.

Everett et al. (1999) found that,

> Given fewer and younger cohorts in riparian than sideslope forests and fewer historical tree numbers in riparian than sideslope forests the current equal dispersion of old trees between sideslopes and riparian areas may be a spurious result of fire suppression since 1910. **Our attempts to protect old trees in the riparian buffers at the expense of adjacent sideslopes may be misdirected if old trees have been historically more numerous on the adjacent sideslopes**.

Ambiguous terminology related to "fire control costs"

Speaking on flame lengths in prairie fires, Brown and Smith (2000) note,

> ... historical prairie fires probably burned much of the time with flame

> lengths of 8 to 15 feet (2.4 to 3.6 m), too hot for direct frontal attack with hand tools.

Ambiguous terminology related to "fire risk"

The 2003 GAO report (p. 12), states:

> Although one of the categories of land targeted for fuels reduction in the draft cohesive strategy is land with excess fuels buildup, **the agencies have not yet accurately estimated the amount or identified the location of these lands**.
>
> ... High Risk. The risk of damage to soil, vegetation, and water quality from fire is high. In forests, there are excess levels of fuels buildup, and on rangelands, nonnative species are predominate. Vegetation composition, structure and diversity have been significantly altered. Consequently, these lands are at the greatest risk of catastrophic, destructive wildland fires. To restore their historical fire patterns-before prescribed fire can be utilized-these lands may require mechanical thinning projects, or reseeding.
>
> Moderate Risk. The role of fire in the ecosystem has been altered, allowing fires to occur less frequently than they did historically. In forests, there are moderate levels of fuels buildup; and on rangelands, nonnative species have replaced some native species. A moderate risk of damage to soil, vegetation, and water quality has been identified on these lands. To restore their historical fire patterns, these lands may require some prescribed burns, mechanical thinning, and the subsequent reintroduction of native plants.
>
> Low Risk. For the most part, fires occur at frequencies and severities similar to historical patterns. In forests, vegetation has not accumulated beyond historic levels, and on rangelands, native species are predominate. Thus, the risk of damage to soil, vegetation, and water quality from fire remains relatively low. Maintenance such as prescribed burns, mechanical thinning, or preventing the invasion of nonnative weeds is required to prevent these lands from becoming degraded.

Mark Morris, Ranger, Tonasket RD, USFS (letter of Aug 23, 2000) had this to say about fire risk:

> Fire risk pertains to sources of or causative agents for wildfires. **Risk deals with the likelihood or probability of an ignition source. Examples of sources and causative agents include: lightning, equipment use, smoking, campfires, debris burning, railroads and power lines, incendiary or arson and children**. ... Our Fire Prevention programs comprise our efforts to educate the public and minimize fire risk.

Sherry Devlin, Montana Missoulian wrote a story, "Distribution of federal funds under scrutiny"(Feb. 20, 2002):

> Largely in response to the massive wildfires that burned in the West during

> the summer of 2000, the federal government compiled a list of 11,376 communities "at risk of wildfire." Any community on the list could then apply for fuel-reduction or wildfire prevention money from the National Fire Plan.
>
> **But there was no common definition of what constituted a 'community at risk'**. "Each state provided a list of the communities they felt were at risk," said Dan Bailey, fire management officer for the Lolo National Forest and a leader of the national wildfire-preparedness program, Firewise Communities.

Ambiguous terminology related to the "Wildland-Urban Interface"

The GAO report (2003), states:

> For the second category....lands in the wildland-urban interface... **the agencies have not specifically defined the wildland-urban interface** so they have been unable to collect data that are relevant nationwide. For example, **the agencies have not decided if it includes only land near residences and commercial development or also land near public resources**, such as power lines and watersheds. **Without a clear national definition, there is no basis for a consistent determination about which lands are part of the wildland-urban interface**.

The GAO report (2003), further states:

> In January 2001, **a definition of wildland-urban interface was published in the Federal Register, but it is very general and consequently, it has been interpreted inconsistently**. The definition classifies wildland-urban interface into two primary categories: **(1) lands where structures are directly adjacent to wildlands and (2) lands where structures are scattered throughout a wildland area**. The definition further specifies that wildland-urban interface includes communities ranging from suburban and urban neighborhoods (3 or more structures per acre) to widely dispersed rural dwellings (1 structure per 40 acres). The breadth of this definition allows for diverse interpretations—including, for example, subdivisions lining forest boundaries, remote summer cabins in the wilderness, or land surrounding powerlines crossing federal lands. On the basis of this definition of wildland-urban interface, the Forest Service and Interior allowed each state to identify a list of communities at risk from wildfire to be published in the Federal Register in August 2001. However, given the lack of specificity in the published definition of wildland-urban interface, each state used criteria it believed appropriate for selecting communities at risk.

Cohen (2001) approaches risk from the standpoint of structure protection:

> The term "wildland-urban interface" suggests that residential fire destruction occurs according to a geographical location. However, this misrepresents the physical nature of the wildland fire threat to homes. **The wildland fire threat to homes is not where it happens related to wildlands but how it happens related to home ignitability**. Therefore, to reliably map the potential for W-UI home fire loss, home ignitability must be the

principal mapping characteristic.

Scott (2003) determined the crown free zone for structures:

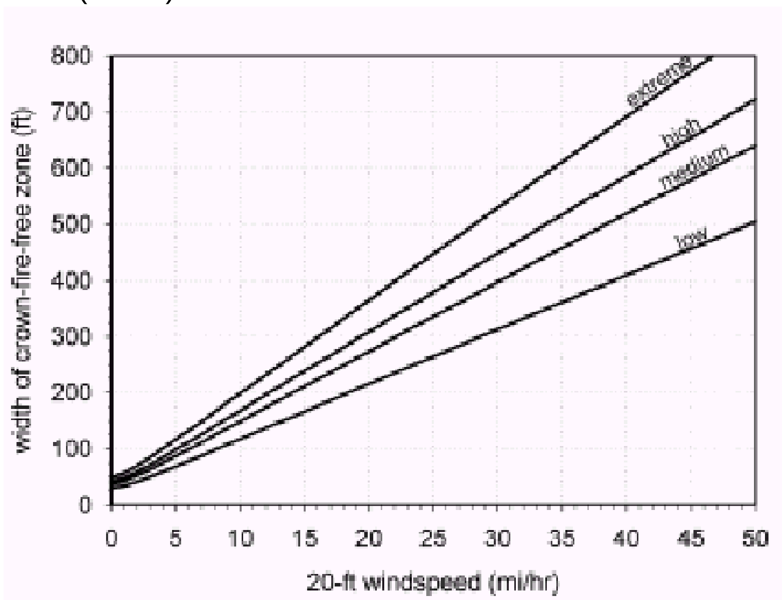

Figure 1—Minimum width of the crown-fire-free zone around a structure as a function of 20-ft windspeed for 4 categories of combined surface and canopy fuel heat per unit area (low = 3500 BTU/ft^2, medium = 5000 BTU/ft^2, high = 6000 BTU/ft^2, extreme = 7000 BTU/ft^2). This chart uses Rothermel's (1991) crown fire spread model to estimate flame length, and assumes level ground, drought summer fine dead fuel moisture conditions (1-hr = 4%, 10-hr = 5%, 100-hr = 7%, live = 78%). Width of the crown-fire-free zone is 4 times the estimated flame length.

Scott (2003) also determined the minimal canopy base height to initiate crowning fires:

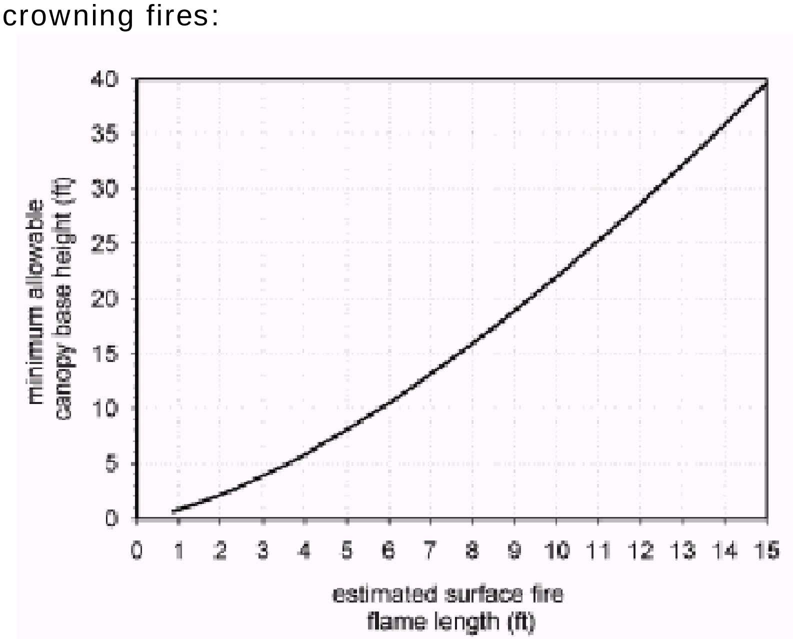

Figure 3—Minimum allowable canopy base height as a function of surface fire flame length, as predicted from Van Wagner's (1977) crown fire initiation model and Byram's flame length model.

The Colville National Forest Geographic Information Systems website (5/2/2002) [http://www.reo.gov/col/data_dictionary/index.html] uses this definition:

> Wildland/Urban Interface (WUI) exhibits national forest lands within two miles of structures on private land. The interface map should be displayed by querying areas where the "cnf_interface" attribute = "interface". **WARNING: This map was derived from structure data that is likely**

incomplete. The purpose was for general application, and may lack the level of detail required for very localized specificity. A more thorough inventory of private land structures may be needed to increase the buffering accuracy if WUI designation seems inadequate. **The assumption is that WUI boundaries will be regarded as somewhat 'fuzzy'**.

Ambiguous terminology related to the "reburn hypothesis"

Beschta et al. (1995) state:

> For example, some argue that salvage logging is needed because of the perceived increased likelihood that an area may reburn. It is the fine fuels that carry fire, not the large dead woody material. **We are aware of no evidence supporting the contention that leaving large dead woody material significantly increases the probability of reburn**. There is a regional need for retrospective analysis concerning the probability and effects of "reburn". Sites exist throughout the western United States where the risk and consequences of reburning of already burned landscapes may be retrospectively addressed. **This analysis must precede any management recommendation based on the probability of reburning**.

Duncan (2002) states:

> The latter, the 'reburn hypothesis,' contends that the removal of dead trees after a fire can reduce fuels and thus the intensity of fires that may occur in the future.
>
> 'You have to look closely at the type of material brought down by a fire, though,' says Roger Ottmar, a research forester with the Seattle laboratory of the PNW Research Station, who provided methodology and data reduction for a recent postfire logging experiment undertaken by McIver.
>
> 'If it is left unlogged, it may indeed increase fire hazard as the fire-killed trees begin to fall and add fuels to the ground. However, that hazard drops dramatically over the years as the material decays and is compacted by snow. Similarly, **the slash left by logging initially increases fuels available to burn if the fuels are not treated immediately; but the fuel level rapidly drops as the slash decays and compacts**.'

Brown et al. (2003) state:

> Reburn results when falldown of the old burned forest contributes significantly to the fire behavior and fire effects of the next fire.
>
> ...The probability of a reburn is higher, to an unknown extent, in heavy accumulations of CWD because of the high fire persistence that characterizes decayed CWD.
>
> ... The amount of CWD that provides desirable biological benefits, without creating an unacceptable fire hazard or potential for high fire severity reburn, is an optimum quantity that can be useful for guiding management actions.

... The probability of a reburn occurrence, which is small for a particular site but high over a large area such as a Ranger District, is not dealt with here.

... Vegetative succession following forest fire including reburns depends on a number of interacting factors including fire severity, prefire vegetation, species adaptations to fire, environmental conditions, and chance (Brown 2000; Lyon and Stickney 1976; Miller 2000; Morgan and Neuenschwander 1988). Although succession depends on many variables, the following principles can provide a general description of plant community development after a reburn.

1. The course of succession is set by the prefire composition of species that survive fire onsite by protected sprouting plant parts and seeds (Stickney 1990). In Northern Rocky Mountain wildfires, which are mostly of moderate to high severity, there is a tendency to get back most of the species that were present before fire (Lyon and Stickney 1976).
2. Many herb and shrub species have sprouting parts such as rhizomes, bulbs, and root crowns that are buried in mineral soil to varying depths.
3. The more severe the fire the higher the mortality and the less the survivor component in both species and number of plants (Stickney 1990). Only deeply buried sprouting parts survive. Resilient species such as pinegrass (Calamagrostis rubescens) and Douglas spirea (Spiraea betulifolia) usually retain surviving plant components. Further additions must come from offsite plants. Offsite colonizers that have light, easily wind- disseminated seeds are favored. Thus, both desired native plant and weed species fitting this category are favored.
4. The pattern of burn severity within a fire relates to the pattern of fuel consumption (Miller 2000). Duration of fire over uninsulated soil largely determines severity.
5. A future influence of unknown consequences on postfire succession is global warming, which may affect fire severity and plant establishment, growth, and mortality (Ryan 2000).

With these principles in mind, some general statements about the effects of a reburn during high to extreme burning conditions with low fuel moistures can be made:

0 to 10 Years After First Fire: High severity fire is unlikely because duff and downed woody fuels that support prolonged burning would be absent. Large woody fuels would still be accumulating through falldown, and they would not have decayed enough to support smoldering combustion, which can extend the period of downward heating. If salvage operations leave concentrations of small woody fuels, high severity burning could occur where the fuels are concentrated. This situation would be aggravated where standreplacement fire did not consume foliage, thus allowing a layer of scorched needles to accumulate as surface fuel. Surviving onsite herbs and shrubs should dominate the recovering vegetation. Newly established trees that regenerate by producing seeds could be lost. Even seedlings of species having sprouting capability could die if their root systems are not well established.

10 to 30 Years After First Fire: Downed CWD would exhibit some decay and support a longer period of burning. A duff layer, however, would not be well established and would be unable to contribute to soil heating. Thus, high burn severity would primarily occur where large woody material was lying on or near the soil surface. High severity fire could be substantial where a large proportion of the soil surface was directly overlain by large woody material, which could accumulate from falldown of a large amount of tree basal area. A limited amount of conifer regeneration might be possible from young cone- bearing trees established onsite after the previous fire. Onsite herbs and shrubs would dominate the recovery vegetation except where burnout of large woody pieces caused deep soil heating, which would occur particularly in the near vicinity of overlapping pieces.

30 to 60 Years After First Fire: Large woody pieces would probably exhibit considerable decay, and a forest floor of litter and duff would be established to a variable extent depending on the density of overstory conifers. Burnout of large woody pieces and duff is assisted by the interaction of these two components (Brown and others 1991). Higher severity burning than would typically occur during earlier periods is possible depending on extent of soil coverage by large woody pieces. If a conifer overstory exists, crowning coupled with burnout of duff could amplify the burn severity. Offsite colonizers would be an important component of the recovery in the more severely burned locations. Prescribed fire during this period could greatly reduce the severity of a reburn wildfire. However, a reburn involving optimum quantities of CWD should not lead to unusually severe fire effects. Historically, fires probably often occurred in the understory and mixed fire regime types when large downed woody fuels were in the optimum range.

Karr et al. (2003) stated:

The Everett Report concurred with key aspects of our report, including our conclusion that **there were no data to indicate that post- fire salvage logging reduced the risk of reburn**. To wit, the Everett Report (p. 4) stated: '**[t]here is no support in the scientific literature that the probability for reburn is greater in post- fire tree retention areas than in salvage logged sites.**' The Everett Report (p. 4) also concludes that the Beschta Report was '**correct that the intense reburn concept is not reported in the literature.**' The Everett Report (p. 5) also states that current research suggests that salvage logged areas may have elevated fire hazard over unlogged sites for the first twenty years after logging. The Everett Report (p. 6) concludes, '**[t]he urgency to remove woody biomass is not based on reducing short-term fire hazard, but on the capture of economic values and reduction of long-term fire hazard.**'

Paysen et al. (2000):

Postburn accumulation of fuel is rapid as most grasses, shrubs, and palmetto resprout within a week of the burn regardless of the season. In denser pine stands, needle drop from crown scorched trees can form a continuous litter fuel bed within weeks of a burn. This rapid accumulation of fuel allows for low intensity reburns on some sites within a year.

The GAO report (2003), states:

> Finally, for the third category--lands that require regular maintenance treatments because the vegetation grows rapidly--the agencies have not estimated the total amount and location of such lands, although they have been reducing fuels on such lands in the Southeast for decades. **Without a nationwide estimate of the amount and location of land in each category of land that is important to treat, it will be difficult for the agencies to assess their progress in reducing the total amount of federal land that requires fuels reduction.**

Everett et al. (1999) states:

"Conversely, once a vegetation type has been created that burns more readily than previous plant assemblages, the probability for reburn is increased."

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