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A Cobblestone Publication • September 2005

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Science to the Rescue

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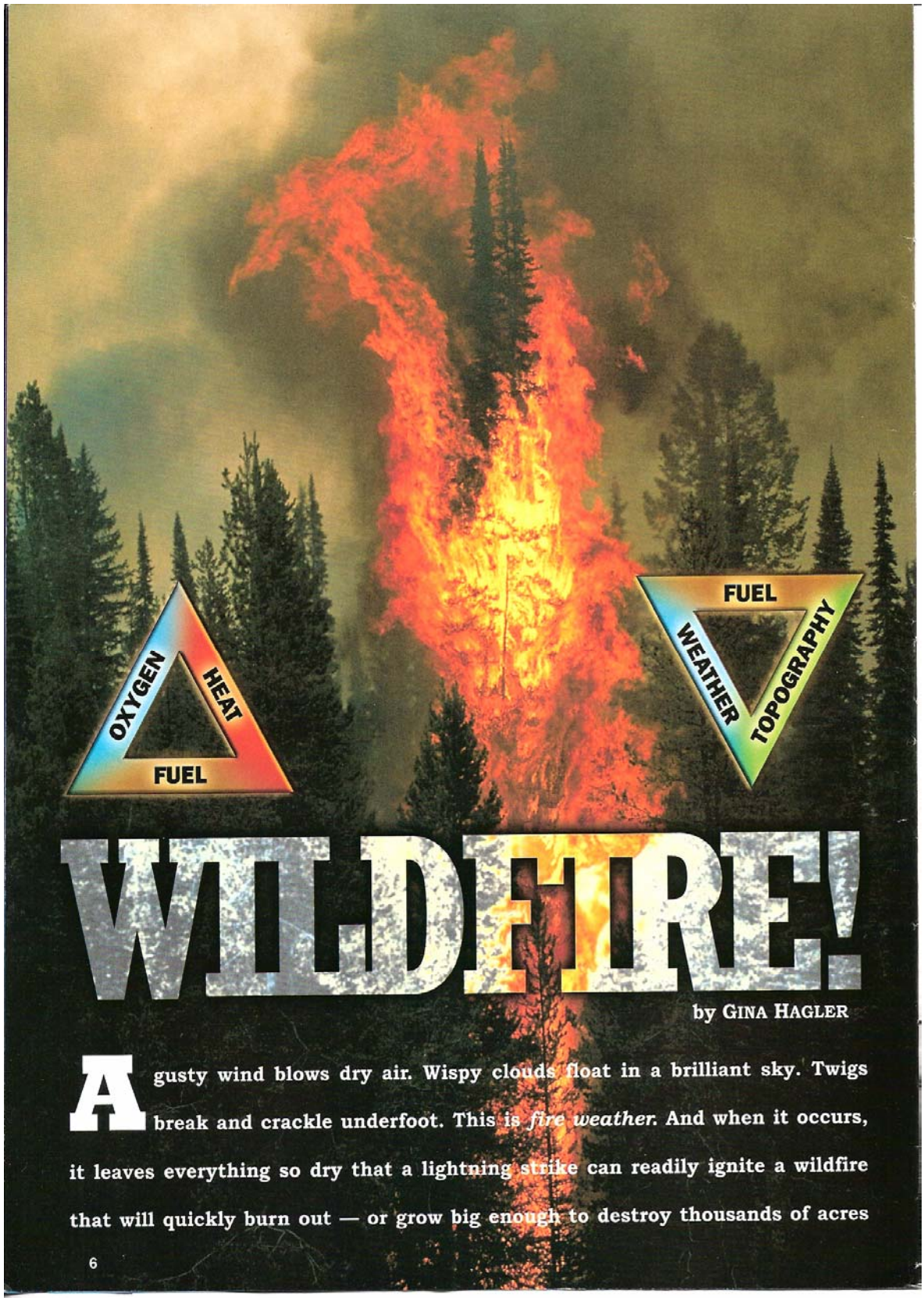
Sci-fi(-ery) Story



WILDFIRE!

by GINA HAGLER

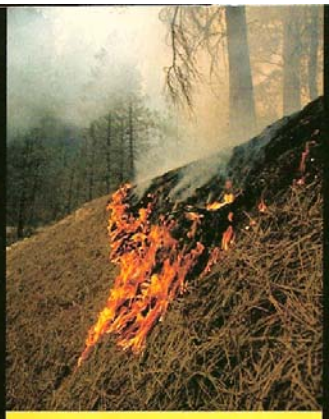
A gusty wind blows dry air. Wispy clouds float in a brilliant sky. Twigs break and crackle underfoot. This is *fire weather.* And when it occurs, it leaves everything so dry that a lightning strike can readily ignite a wildfire that will quickly burn out — or grow big enough to destroy thousands of acres

and generate smoke that can be seen from space.

In the Bitterroot National Forest of Montana in the summer of 2000, the fires didn't burn out. "It was hot. Miserably hot and dry. Without any reprieve in the evenings," says Monique Lay of Montana Disaster & Emergency Services. "That summer of 2000 here definitely was fire weather." The Bitterroot fires burned out of control for three solid months, spreading across close to 300,000 acres, before they were extinguished.

Triangulating a Wildfire

Wherever a wildfire occurs, it starts the same way. A fuel source (grass, leaves, pine boughs) is ignited by a heat source (spark, ember, lightning strike). These two things — fuel and heat — join with a third — oxygen — to make up the sides of the Fire Triangle. At ignition (when burning begins), they combine to create the chemical chain reaction that we call fire. But just because a fire starts doesn't mean that it will continue to burn. If the fuel is too damp, the air too cool, or the initial heat insufficient, the fire will lose a lot of heat. To continue and grow, a fire needs additional fuel, and a favorable combination of weather and topography (land features, including hills, ridges, valleys) — the three elements that make up the Fire Behavior Triangle. The only way a fire can exist is for the elements of the Fire Triangle to interact successfully with the elements of the Fire Behavior Triangle.



Ground fire spreads as it burns dead roots and other material under the ground.

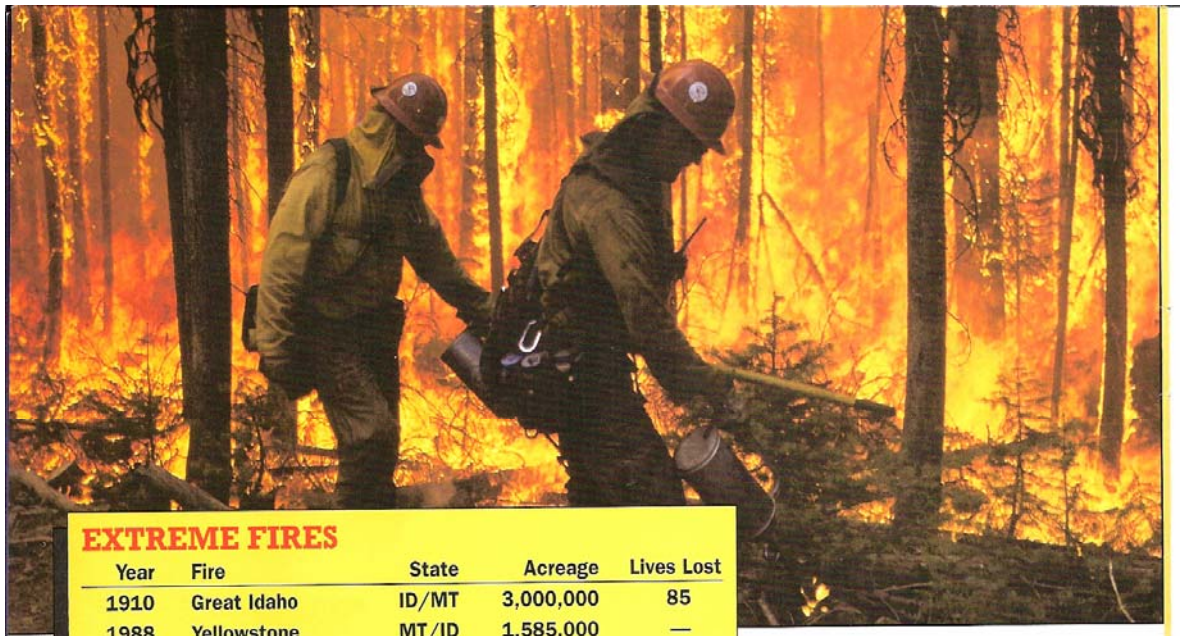
Feeding the Fire

Because a fire is in constant need of something to ignite and burn (fuel), it moves fastest in the direction offering the most abundant fuel for the least amount of effort (heat loss). For instance, on a windy day the force of the wind pushes the flames forward and near to the ground. This causes the fuel in front of the flames to lose moisture more rapidly than the fuel in other directions. Since dry fuel burns more easily than damp fuel, the fire moves forward rapidly with the blowing wind. Likewise, depending upon the weather and the distribution of available fuel, a fire will burn dead roots and material under the ground (ground fire); the logs, twigs, dead leaves, and bushes on the ground (surface fire); or the living and dead trees and vegetation above the surface (crown fire). It may also use vines and hanging boughs as ladders to burn a combination of all three.

The Bitterroot fires burned out of control for three solid months, spreading across close to 300,000 acres, before they were extinguished.

Fire spreads from the ground to the tree canopy in four ways: 1. Fuels on the surface burn hot enough to preheat and ignite the canopy. 2. Fire climbs partially fallen trees. 3. Fire ignites understory (smaller) trees. 4. During extremely dry conditions, fire may climb the downwind side of tree trunks, where gaseous fuel accumulates.

(From The Book of Fire *— see p. 9; used with permission.)*



EXTREME FIRES

Year	Fire	State	Acreage	Lives Lost
1910	Great Idaho	ID/MT	3,000,000	85
1988	Yellowstone	MT/ID	1,585,000	—
1990	Dude	AZ	24,174	6
1994	South Canyon	CO	1,856	14
2000	Bitterroot Complex	MT	292,070	—
2000	Rodeo/Chediski	AZ	450,000	—
2002	Biscuit Complex	OR/CA	499,965	—
2002	South Hayman	CO	138,000	—

*Data taken from Historical Wildland Fire Statistics and individual sites for most recent fires (**www.nifc.gov/stats/historicalstats.html**).*

If a fire grows intense enough, it can make its own weather! The gases released during combustion expand near the ground and, being lighter than air, begin to rise. Embers, smoke, debris, and the water vapor produced during combustion are sucked up into a column of rising gas. This turbulent column, called a ***convection*** column, can create ***cumulonimbus*** clouds, complete with rain, above them. At its base, cooler air rushing in to fill the space left by the rising gases increases the combustion rate, adding to the intensity of the fire and creating still more firebrands (burning embers) to rise up in the convection column. "It's tremendously noisy with all that oxygen moving around," says Chris Young, Parachute Loft Foreman for the Grangeville Smokejumpers of Idaho. "It sounds like a freight train coming through, and there's also lots of crackling and popping." Winds closer to ground level (surface winds), which are not strong enough to disrupt the column, add to the noise as they are forced to go around it. Surface winds that do disrupt the column carry firebrands up to a mile or more away to start new fires. This dramatic increase in the fire's rate of combustion and spread, intense radiation, and crowning is called a firestorm.

Convection — The transfer of heat or other atmospheric properties by massive motion within the atmosphere, especially motion directed upward

Cumulonimbus — Extremely dense, white, fluffy cloud, extending to great heights and usually producing heavy rain or thunderstorms

The Bitterroot Complex Fires were an "extreme" fire that burned on the Montana/Idaho border from July through September. (See Table of Danger ratings, opposite page.) Dixie Dies, Public Affairs Officer of the Bitterroot National Forest and member of a local fire crew, "saw the smoke from the columns from 50 miles away. A member of another crew who flew over the columns said that they reached 30,000 feet!" When a fire burns with enough power to be classified "extreme," it's far too hot, unpredictable, and dangerous for people to fight up close. All that's left is for firefighters to work with the existing weather and topography to influence the elements of the Fire Triangle by cutting off oxygen, fuel, and/or heat.

Wildland Fire Assessment System Danger Ratings & Color Codes

Fire Danger Rating	Color Code	Brief Description
Low (L)	Dark Green	Fires do not ignite readily. They will spread slowly.
Moderate (M)	Light Green or Blue	Fires can start from most accidental causes. Control is relatively easy.
High (H)	Yellow	Fires start easily from most causes. Fires may become serious and difficult to control.
Very High (VH)	Orange	Fires start easily and spread rapidly. May quickly develop high-intensity characteristics.
Extreme (E)	Red	Fires start easily, spread furiously, and burn intensely. Will not be extinguished by control efforts until a change in weather or fuel supply.

Information taken from "Adjective Fire Danger Class Descriptions" (found at www.fs.fed.us/land/wfas/nfdr_adjective.html).

Starving the Fire

Because a fire's heat causes water to evaporate before it can reach the flames, water cannot be used to deprive an extreme fire of oxygen. Firefighters must work instead to keep the fire from reaching additional fuel. "Firefighters look at the existing topography and decide where the best place is to get a toehold — a place where they can create a firebreak by back burning or disrupting the available fuel," says Dan Bushnell of the Montana Department of Natural Resources and Conservation (MDNRC). If the break "holds," the lack of fuel will keep the fire from spreading.

It's not unusual for an extreme fire to burn for months before it's extinguished, largely due to a change in the weather conditions or the season. "The trick is to work with the weather to your advantage to get a line around the fire to contain it," says Young. Then, when cooler temperatures or even cloud cover slow down the fire, you can fight it and eventually suppress it." In the case of the Bitterroot Fire, this is exactly what happened. The fires were ultimately extinguished with the help of the cooler temperatures and rains that came with the autumn.

With so much at stake, models to predict fire behavior and systems to forecast fire risk are important tools for managers of wildlands. The widely used BEHAVE computer model incorporates fuel, topography, and weather as variables to predict surface fire behavior in real time. The models are used to help allocate resources at a fire site. The Wildland Fire Assessment System (WFAS), available at **http://wfas.net/cgi-bin/nav.cgi**, gives detailed, up-to-date information about fire potential, including a color-coded National Fire Danger Map based on satellite data that illustrates the amount of dry fuel available in any area.

It's hard to believe that the fire you start when you strike a match could grow to be something so big that it creates its own weather. But the principles at work when you light that match are the same ones at work in a wildfire. You can do your part to protect our wildlands by paying attention to fire-risk levels and by using good judgment when you visit. (See "Marshmallows, Anyone? How to Build a Safe Campfire," p. 12.)

Gina Hagler is a freelance writer in Rockville, MD.

FOR MORE INFORMATION:

The Book of Fire by William H. Cottrell, Jr. (Mountain Press Publishing Company, 2004); 1-800-234-5308 or **www.mountain-press.com**.