Fighting the Wild Flames

BY VIRGINIA HUGHES

IN THE SUMMER OF 2005, AMIDST THE REGION'S WORST DROUGHT in six decades, wildfires sparked across the forests of northern Portugal. By Aug. 6, more than 2,000 firefighters were tackling two dozen fires across the country. Over the next three weeks, increasing temperatures—up to 104 degrees Fahrenheit (40 degrees Celsius)—and strong winds further fueled the blazes, the largest of which spanned 13 miles.

With its modest firefighting resources tapped out, the Portuguese government called on its European neighbors for help. France and Spain sent in firefighting planes, while Germany and Holland each sent several helicopters. At the peak of burning, close to 800 firetrucks and 31 airplanes and helicopters were in use.

By the end of August, the air humidity rose, temperatures fell and the major fires were put to rest. But the damage had been done. All told, fires had scorched more than 741,000 acres of forest land, destroying more than 100 homes and 500 farm buildings. A total of 13 Portuguese civilians and 10 firefighters died.

Villagers watch as the flames burn trees on a hill opposite the village of Sao Frutuoso, Portugal in 2005, left. Residents of the village of Sabugueiro, near Seia, in central Portugal, try to beat back the flames from a wildfire, right.

As devastating as Portugal's 2005 summer was, fires of that magnitude are nothing new, and are becoming increasingly frequent all over the world. In 2000, an estimated 865 million acres of forests and woodlands were destroyed by fire, with 80 percent found in the ultra-dry savannas of sub-Saharan Africa and the islands of the southwest Pacific, according to the Food and Agriculture Organization of the United Nations. In 2004, a whopping 4.2 million acres burned in the most northern forest of the Yukon Territory, and another 6.7 million acres in neighboring Alaska. Russia's 2007 fire season saw almost 14,000 fires, damaging more than 2 million acres. As for the continental United States, last year the explosive spree of fires in Southern California alone burned more than 1.3 million acres. (See sidebar, page 15: By the Numbers.)

How do governments handle such a large-scale disaster? Forty years ago, the universal fire management strategy was to prevent as many fires as possible; and for those that started anyway, to suppress them.

That all changed around 1970, when scientists realized that fire is most often a natural and healthy part of forest ecology and should sometimes be permitted. "Before, the agencies' mentality was to put everything out as soon as it starts and as quickly as you can," explains Tory Henderson, branch chief for equipment and chemicals for the U.S. Forest Service. "The biggest change in the last 20 years is how we've learned to use fire to benefit the ecosystem."

Today, a large, international network of fire managers studies the climate and ecological conditions under which to set controlled fires. (See sidebar, page 12: Prescribed Fires.) They also design sophisticated mathematical models to predict when and where the big fires will rage. They use high-tech satellite systems and gadgets that spot actual fires in real time. And if they determine that a fire should be squelched, they send in skilled firefighting troops by air and by land to put out the flames before they destroy acres of vulnerable terrain.

Still, none of these technologies by themselves can put fires to rest. As Marty Alexander, longtime fire behavior researcher in the Canadian Forest Service, says: "At the end of the day, it's still the guy on the ground, with a shovel and an ax, who's doing the real work."

Making Predictions

Though the basic tools for firefighting—the planes, trucks, repellants and hand tools—haven't changed much since World War II, fire prediction technology has improved significantly. "Before, say, 1980, we used pretty rough-and-ready methods," says Alexander, who specializes in modeling fire behavior. "Now we can actually make some sound predictions."

Fires are most prevalent in places that have a wet season, when trees and vegetation can grow quickly, followed by an extended dry season where that vegetation—or "fuel"—becomes extremely flammable. Fires are most likely to spark during long periods of drought, with low air humidity and high temperatures. When high winds or lightning storms are added to that mix, fires spread quickly—up to 40 miles in a single day.

Starting about 25 years ago, fire scientists created sophisticated mathematical predictive models based on a variety of climate and ecological factors. "To a large extent, our models can only be as good as the weather forecast is," Alexander says. "So you can build two different models: one

Ask a Smoke Jumper

Brandyn Harvey, 31, is one of about 400 American "smoke jumpers"—those elite, highly trained firefighters who drop from airplanes via parachutes to put out the wild flames in remote areas. Harvey, who hails from Boise, Idaho, also worked for six years on a "Hot Shot" firefighting crew, where he not only fought fires but also did prescribed burnings. We caught Harvey in between trips and asked him about his training, firefighting gadgets and the thrill of the jump.

What is your job? Do you love it?
I love it, yeah. Throughout the fire season we will be sent out to different locations, depending on fire activity at the time. We'll ship out with eight to 12 smoke jumpers, set up shop. We could be ready at the airport within minutes of getting a call, then we're off the ground and jumping into wildfires.

It's the pinnacle of the firefighting realm. I was pretty lucky to be selected and to have the support I had from my old Hot Shot crew. We have the most fun job, I think, getting to parachute in and put out fires. And since we're a national resource we get to travel a lot.

A lot of my friends joke with me and say I should talk about my job more, because it would help me pick up chicks [women].

Is it scary sometimes?
It's definitely full of adrenaline. A lot of the guys and gals that do it are super athletic because we have to be at the top of our game. We have to jump out of airplanes, and hike 20 miles at a time. The training is very rigorous. A lot of people compare it to the Navy SEAL program.

What was your training like?
Initial training for smoke jumping was six weeks. The first week was pretty tough. They took us up in the woods, hiked us around. They really push you to your physical and mental peak. You have to be an Olympic athlete when it comes down to it, suck it up and push your body further than you ever have before. They want the best. They usually wash [release] half of the rookies every year.

How much does one parachute cost?
Probably a couple grand [$1,800 - $2,000]. Then we've got reserves with us, and harnesses are probably another $500 with all the gadgets. We build all of our own equipment. There's a whole fleet of sewing machines that fabricate everything we have. We try to constantly evolve with lighter, newer fabric, protection pads, whatever.

Besides parachutes, what kind of technology or gadgets do you use?
We use altimeters when we jump. And we use GPS's [Global Positioning Systems] constantly. They're probably our best friend, especially in Alaska because there aren't a lot of landmarks. We use radios, too, and laptops for fire behavior calculations.

Cell phones are detrimental, because we don't get service usually. So we use satellite phones if we're out in the desert. To get the satellite phone to us they'll drop it down in a little mini-parachute.

How often do you travel?
All summer usually, sometimes 21 days straight. In a good fire season we'll work 1,200 or 1,300 hours worth of overtime. We work a year's equivalent in six months. I usually get the winters off a little bit, so I'll travel around, snowboard and do odd jobs.

What is the most surprising thing about your job?
Well, the guys I work with are some of the biggest do-ers you'd ever meet. If there's no fires, we'll go do flood relief or go help with Hurricane Katrina. We're an all-incident resource. We picked up space shuttle pieces from old shuttle recovery in Texas.

Any advice to aspiring smoke jumpers?
When you do this, put everything on the line. If you don't make it, you've got to go find another job.

Prescribed Fires

In 1974, four years after one of California's worst fire seasons in history, Clive Countryman, head of fire behavior studies at the U.S. Forest Service's station in Berkeley, Calif., published an influential study addressing the problems of fire suppression. He put forth a thesis that shocked the rest of the field: One way to prevent large, destructive wildfires is to intentionally start smaller ones.

Prescribed fires, Countryman argued, would burn up dry, flammable vegetation or "fuel" before it could accumulate and lead to uncontainable fire conflagrations.

"Fire is not going to go away unless we build a whole lot of parking lots," the Canadian Forest Service's Marty Alexander says in reference to Countryman's idea. "We have to somehow coexist here, and we're not going to do that by fire suppression alone. You have to have some prescribed fires in the ecosystem."

Today, fire managers across the world routinely use prescribed fires (also called controlled fires). Determining when and how to set one is a complicated science that depends on, among other factors: the type of trees being burned, the time since the last fire in the area, past and current moisture content of the air and—because of the smoke—public relations.

"A lot of the grassland areas have lots of acreage that's got to be burned by a certain deadline. You can't just do it any old day," says smoke jumper Brandyn Harvey, who worked for several years on a "Hot Shot" crew that set prescribed fires throughout the western United States. That's because Hot Shot crews have to start the fires when weather conditions are most favorable, to minimize the chance that changing winds could spread them to undesignated areas or that an unplanned fire will spark while the crews are working.

Most prescribed fires are started by ground crews using a hand-held drip torch. For starting fires in larger areas, crews will use power torches mounted on all-terrain vehicles.

based on the worst-case scenario and one based on the most likely case." As well as temperature, humidity and wind speed, the models factor in the volume and moisture content of the "fuel."

More recently, these quantitative models were merged with geographic information systems (GIS), so that the precise location, size and trajectory of the most likely fires would appear on a map. The maps and data are available from a central Web site, and may be downloaded to firefighting crews' laptops or fire operations centers throughout the world. "Now on a computer you can actually show what the perimeter of land burned would look like after one hour, or two hours. It helps in all kinds of scenarios," Alexander says.

Spotting a Fire

Effective predictive techniques are important because they allow firefighting organizations to plan ahead, directing equipment and staff to the areas most at risk. But just as important is quickly pinpointing actual fires. The faster a fire is spotted, the less damage it can do before a firefighting crew can extinguish it.

In most places, fires are detected by regular patrolling of likely hot spots by single-engine manned aircraft. But in recent years, communities frequently plagued by wildfire have turned to remote technologies, such as NASA satellites that detect dry areas, smoldering fires and the infrared signatures of carbon dioxide emissions.

The newest of these satellite technologies is called the Moderate Resolution Imaging Spectroradiometer, or MODIS, a sophisticated instrument that's found on two satellites orbiting the Earth. MODIS holds a variety of sensors that detect electromagnetic radiation—whether visible light, microwaves or infrared heat. MODIS systems scan the entire Earth's surface every one to two days. Once that data on smoke and fire radiation is sent back to Earth, NASA geographers merge it with maps of local roads, topography, vegetation and population density, and disseminate it to firefighting operations across the world.

"We can access the satellite information over the Web—it's updated twice daily," says Lachlan McCaw, a bushfire research scientist in Western Australia's Department of Environment and Conservation. "That's proven extremely effective." He says satellite technology is especially useful for detecting fires in Western Australia, which is largely unpopulated and difficult to monitor with planes.

Still, MODIS data can't show how fire radiation is changing from one hour to the next. Last summer, NASA and the U.S. Forest Service started experimenting with remote sensing technology on unmanned aircraft, rather than using satellites. The sensors could monitor the spread of a specific fire as it happens, and send the data back to geographers in near real time.

The new technology was tested in October 2007, when raging fires broke out in San Diego County, Calif., with

A MODIS image of the Viejas Fire near San Diego, Calif. The image of this wildfire was taken on Jan. 4, 2001, by the Moderate Resolution Imaging Spectroradiometer (MODIS), flying aboard NASA's *Terra* spacecraft. The scene shows the wildfire and smoke plume from the Alpine region, east of San Diego, left. Firetrucks and men assemble to fight a wildfire from the ground, right.

mixed results. The system worked perfectly until large clouds got in the way of the infrared sensor. Developers are now working to address the problems. Using unmanned aircraft "would expand our capability a great deal, because right now we have a limited infrastructure built for infrared technology," says Henderson of the U.S. Forest Service.

But fire spotting doesn't have to be so high-tech. In some parts of Western Australia, firefighters keep watch in treetop towers during the fire season. Because the local geography is fairly flat, there's no other way to get a good view. "You get a guy to climb up a tree, using spikes in the sides [of his boots], step into a small cabin structure, and look out," McCaw says. "They've been doing it that way for a very long time."

Extinguishing the Flames

Once a fire's been spotted, the first decision for local officials is whether they want to spend money and firefighting resources to extinguish it. Small fires, especially those far from populated areas, should sometimes be left to burn. Burning these small amounts of shrubs and bushes can prevent a more dangerous fire from breaking out in that area in the future.

"You also have to look at what the land's purpose is," says McCaw—that is, whether it's a national park, nature reserve, national forest or remote grassland. Fires are sometimes left to burn for weeks or months in places like Australia's "unallocated crown lands," which are government-owned, unpopulated and not actively managed. "There's no clear reason to put firefighters at risk putting those fires out," he says. In contrast, of the approximately 700 large wildfires that occur in Western Australia every year, at least half "would have the potential to affect rural or residential property," he says. "So, we obviously have to contain those as quickly as possible."

The swift, coordinated, strategic effort from firefighting crews is often compared to a military operation. In the United States, crews work under a chain of command, from regional volunteers to state control centers, to the National Interagency Fire Center. About 100 "Hot Shot" crews, made up of highly skilled firefighters trained and employed by the federal government, travel around the country to help local authorities as needed. Similarly, the Bureau of Land Management and the U.S. Forest Service have trained about 400 "smoke jumpers" who parachute directly into raging fires.

The standard response to a wildfire is called a "single resource initial dispatch," in which a small number of firefighters take a bulldozer and a fire engine to the scene of the fire and suppress it with water. Three things are necessary in order for a fire to burn: a heat source, oxygen and receptive "fuels," the latter being the easiest one for firefighters to remove. The fuel along the perimeter of the fire is bulldozed, cutting off its ability to spread. Then, the water extinguishes it.

That's the simplest case. For more extreme weather conditions, a fire could easily advance faster than the initial dispatch can contain it. In those cases, the initial dispatch crew would contact the coordination center and request additional resources. This gets complicated when multiple fires are going on at once, with more anticipated for later in the day or the week. "Usually, we're not worried about fighting the current fire," says Chris Worrell, a fire training officer in the Florida Division of Forestry. "The question we have to ask is: where is the next fire going to be? It's a constant game of catch-up."

Fires larger than about 10 acres can't be stopped by land crews alone. Manned aircraft—often retrofitted military planes and helicopters from World War II—fly to the outbreak to drop water or chemical retardants. The largest planes, six-wing aircraft, hold up to 3,000 gallons of liquid. Much more common, however, are large air tankers that hold about 1,200 gallons and single-engine planes that carry 600 gallons.

If chemical retardants are dropped just after a fire has started, they can keep it from spreading until ground crews reach it. Since retardants last much longer than water, they also can be dropped in places where a fire is anticipated to spread. The chemical retardants (usually phosphorus-based) are usually colored red so that air crews can see where they landed.

Other than small developments in the chemistry of retardants—they've been made less toxic so that they can be dropped closer to waterways without poisoning local fish—aviation fire technology hasn't changed much in the last 30 years. "The last innovation we had was the flying drip torch in the mid-1970s," says Alexander. The drip torch, also known as a "helitorch," is a device that swings from a helicopter and dispenses and ignites fuel. "Basically, it's a way to fight fire with fire," Alexander explains. Adding fire to strategic areas next to or near an existing fire can reduce its intensity or steer it into a trajectory that will cause minimal damage.

Dixon vs. Fire

The following Dixon Powhatan products are used in the firefighting industry:

- Nozzles
- Back pack systems
- Accessories
- Couplings
- Adapters
- Valves
- FRLs
- Fire hose

Coordination among the various local, state and federal agencies is probably the most vital element to suppressing a fire. "The best way to describe it is like a spider web," Worrell says. The National Interagency Fire Center sits at the center of the web, and strings connect to one of eight regions. Each of those strings connects to another cluster of states, which, in turn, connects to counties and local municipalities. The entire web is mapped out on a central database.

"We can tell the system we need additional help here in Florida, and within 24 hours we have firefighters show up from California, Texas, all over," he explains. After 23 years on the job, Worrell says he's fought fires "in every state west of the Mississippi."

The cooperation doesn't stop at national borders. In the same way the European Union member countries pitched in to help Portugal in 2005, American, Canadian and Mexican operations share resources when in need. During the winter off-season, many American firefighters even fly to Australia to help in what is their summer fire season, and vice versa.

"I believe in what I do," Worrell says. "There's nothing more gratifying than showing up somewhere with minimal resources, making sound and quick decisions, and saving people's homes and lives."

Arson

Last fall, wildfires engulfed more than a half-million acres of Southern California, thanks to extremely dry conditions, high winds and—at least for a rural community in the northern part of Los Angeles County—a 10-year-old boy with a box of matches.

On Oct. 22, the Los Angeles County Sheriff's Department apprehended the young arsonist, who claimed that he "accidentally" set off the 38,000-acre fire.

Fire authorities suspected that several of the large California fires that year were intentionally set. FBI investigators collected evidence and more than $150,000 in reward money was offered for accurate information about the arsonists. At least three people were arrested on charges of arson.

Though investigators immediately suspect foul play whenever a fire has many points of origin, there are no official statistics recorded in the United States on the number of wildfires started by arson.

A chemical retardant is released from a plane in order to keep a wildfire from spreading.

By the Numbers:

Yearly averages of area burned, by region:

Rank	Country	Hectares	Acres	Square Miles
1	Sub-Saharan Africa	230,000,000	568,342,377	888,035
2	Australasia (mainly Australia)	54,500,000	134,672,433	210,425
3	Southeast Asia	6,900,000	17,050,271	26,641
4	North America	4,100,000	10,131,321	15,830
5	South Asia (mainly India)	4,100,000	10,131,321	15,830
6	South America	2,900,000	7,166,056	11,197
7	Central Asia	2,000,000	4,942,107	7,722
8	Northeast Asia	1,000,000	2,471,053	3,861
9	Mediterranean	700,000-1,000,000	1,729,737-2,471,053	2,703-3,861
10	Caribbean, Mexico and Mesoamerica	446,000	1,102,090	1,722
11	Balkans	156,000	385,485	602
12	Baltic and adjacent countries	32,000	79,073	124

(Data collection periods vary by area, but range from 1984-2006. Source: Food and Agriculture Organization of the United Nations' Global Forest Resources Assessment, 2005.)