



### NATURAL DISASTERS

## Wildfires Ignite Concern

Every year in the United States wildfires destroy hundreds of homes and cause millions of dollars in damage. From January through May of this year, for example, 2,702 wildfires scorched 198,228 acres in Florida amidst one of the worst droughts in a century. Although wildfires can actually be good for the environment, helping it to stay healthy and restore itself, they can have harmful human consequences, both directly and indirectly. People in close proximity to a wildfire, such as firefighters, can suffer respiratory problems and burns, and in rare instances are killed. In addition, people living near a fire's burn who are predisposed to environmental health problems such as asthma and emphysema may be affected. Perhaps more importantly for those living downwind, forest fire smoke contains many contaminants that in the long term can, depending on the length of the exposure, produce both acute and chronic effects in humans.

Wildfires are characterized as brush and forest fires that commonly happen in relatively undeveloped areas. But as Craig Allen, a research ecologist with the U.S. Geological Survey in Los

Alamos, New Mexico, points out, "More and more people are living in what were once remote areas, and that's putting them closer to woodlands and the threat of wildfires."

According to a 1994 scientific study prepared for the Fire and Aviation Management division of the U.S. Department of Agriculture Forest Service, contaminants of forest fire smoke can include carbon monoxide, hydrocarbons, benzo[a]pyrene, nitrogen oxides, volatile oxygenated organic compounds, acids, ketones, alcohols, and aldehydes, among other chemicals. Chronic exposure can lead to allergies, bronchitis, and emphysema, while acute exposure can cause impaired judgment, eye and respiratory irritation, and even death. But although some gases commonly released in burning, such as methane and ethylene, have been shown to be carcinogenic in tests on laboratory animals, no scientific evidence exists to show that wildfires can increase these gases to dangerous levels in the environment.

In addition to their human health effects and obvious damage to the landscapes they burn, wildfires can have other unwelcome environmental effects as well. They affect water quality by destroying vegetation and dead plant matter that slows stormwater

runoff; runoff and erosion can increase by an order of magnitude after a wildfire. The extra sediment and ash can also affect aquatic habitats and occasionally kill fish by cutting off the oxygen supply. Furthermore, the threat exists that fire fighting can stress smaller water and power utilities to the point that community drinking water supplies could be adversely affected.

Concerns about water quality have also been raised in connection with the chemicals used to fight and control fires, including fire retardants (composed of ammonium salts, thickeners, corrosion inhibitors, and coloring agents) and fire-suppressant foams (composed of surfactants, stabilizers, and solvents). Between 1994 and 1997 alone, U.S. fire fighting operations used more than 92 million gallons of these chemicals.

"These chemicals have been used in environmentally sensitive areas, so we have done research to determine their impact on plant and animal life," says Susan Finger, an ecotoxicologist and program coordinator for the Columbia Environmental Research Center in Missouri. She says, "Although no effects associated with fire chemical application and exposure were apparent on terrestrial organisms [including humans], potential adverse effects were identified for some of these chemicals in aquatic ecosystems." Finger explains that the introduction of some of these chemicals during a critical time in the life stage of an endangered salmon population, for example, could result in high incidence of mortality or even, potentially, elimination of the population from a localized area. "For this reason," she says, "caution is encouraged when using these chemicals in and around aquatic environments."

In 1995, the federal government established a national fire policy. The policy addresses how resources and personnel can be better used to control fires and recognizes the importance of further research to understand fires and their ecological significance. In a December 1995 memorandum, the secretaries of agriculture and the interior wrote, "The philosophy, as well as the specific policies and recommendations, of the report continues to move our approach to wildland fire management beyond the traditional realms of fire suppression by further integrating fire into the management of our lands and resources in an ongoing and systematic manner, consistent with public health and environmental quality considerations." —Ron Chepesiuk



**Afterburn effects.** Besides landscape destruction, wildfires—as well as the chemicals that are used to fight them—can cause many other kinds of environmental harm to drinking water resources, wildlife, and near-by humans.

## MYCOTOXINS

## Clothing Spreads Spores

Hospital patients who are immunocompromised, for example due to AIDS, chemotherapy, or organ transplants, are highly susceptible to opportunistic fungal infections caused by inhaling spores of the fungus *Aspergillus*. Spore-related illnesses such as pulmonary aspergillosis can account for up to 40% of deaths among leukemia patients. If bone marrow transplant patients become infected, the death rate may exceed 90%. Infectious disease specialists know that bacteria can spread disease via contaminated clothing. Recently, researchers published the first research showing that clothing also spreads *Aspergillus* spores.

“Clothing can create a microenvironment where contaminants are sloughed off very close to a patient, yet an air monitoring system would not pick up a local problem,” says Betsy Dart, a protective clothing consultant at Arthur D. Little, a research and development consulting firm in Boston, Massachusetts.

In 1998 and 1999, Dart—then a graduate student at Cornell University in Ithaca, New York—and Cornell textiles professor Kay Obendorf examined how seven types of fabric harbor and disperse *Aspergillus* spores. They found that cotton fabric spreads spores better than other fabrics. Their findings were published in 2000 by the American Society for Testing and Materials in a collection of papers titled *Performance of Protective Clothing: Issues and Priorities for the 21st Century, Seventh Volume*.

The researchers deposited a known number of spores on swatches of cotton, polyester, rayon, and lycocell (sold as Tencel) in a specially built contamination chamber. The fabrics were exposed for 2 minutes to a mild airflow (2.5 L/min),

equivalent to the gentle breeze generated during a slow bike ride. Photomicrographs taken with a scanning electron microscope revealed that cotton's surface morphology—the physical structure of its fibers—favors the retention and slow release of spores. The cotton fibers twist and cross each other, making “lots of little concave hiding places of just the right diameter to catch spores,” says Dart. (In contrast, rayon, polyester, and lycocell fibers appear smoother, with less contact area for spores.)



**Unhealthy hitchhiker.** Fungus spores that attach to clothing can expose hospital patients to deadly opportunistic infections.

In addition, cotton can soak up more moisture, which reduces static electrical attractions between the spores and the fabric; cotton therefore has a greater propensity than other fabrics for releasing spores, says Dart.

Extrapolating from their laboratory tests, the researchers theorize that simply walking into a patient's room can dislodge spores that cling to visitors' clothing. “Hugging, kissing, sitting on a patient's bed, or pulling up a chair creates air turbulence and friction within and around fabric, releasing potentially deadly spores,” says Obendorf. The researchers recommend that visitors and staff wear protective gowns, caps, and shoe coverings near immunocompromised patients. Laundering effectively removes *Aspergillus* spores, so hospital-laundered protective garments could significantly reduce the risk of infection.

In an unpublished study, Andrew Streifel, a hospital environmental specialist at the University of Minnesota in Minneapolis who also has studied this spore-carrying phenomenon, compared clinical *Aspergillus* isolates recovered from pediatric versus adult bone marrow transplant patients. Pediatric patients had a greater *Aspergillus* isolate recovery, probably because “family and staff hold children in close contact, and spores pass from clothing to patients,” postulates Streifel. The Cornell researchers' study “finally puts science behind our observations,” he says. —Carol Potera

## Touring and Trashing

In March 2001 in Berlin, the World Wide Fund for Nature (WWF) issued a warning at the world's largest tourism convention about the dangers to the Mediterranean coastal environment from projected increases in tourism. The region's annual influx of tourists is expected to increase from the current 220 million to 350 million in 20 years.

High-density tourist attractions can quickly transform large sections of previously pristine coastal areas, leading to habitat loss, soil erosion, marine pollution, and increased competition for already stressed water resources. The WWF identified 13 coastal and marine sites as crucial to preserve in order to protect the Mediterranean's biodiversity. The WWF urged the region's various governments to halt new tourism developments until measures are enacted to protect key areas of biodiversity and promote sustainable natural resource use.

## New Solar System

The world's largest solar power project is scheduled to begin in September 2001 in the Mindanao region of the Philippines. The \$48 million joint project of the Spanish government and BP Solar will provide 400,000 Filipinos with their first electricity. The new solar power systems will help to reduce dependence on nonrenewable energy sources such as trees and thereby slow deforestation, as well as reduce air, water, and noise pollution as loud and leaking diesel generators are replaced. In addition, 44 solar-powered community health clinics will be built during the project's second phase.

## Boiling Temperatures

Greenpeace has accused chemical manufacturer Unilever of dumping several metric tons of toxic waste from the company's mercury thermometer manufacturing plant into the southern Indian resort area of Kodaikanal and the surrounding Pambar Shola nature preserve. The waste was allegedly left in open or torn sacks outside the factory in an area leading to the preserve or delivered to local waste dealers, who were not informed of the possible health hazards of the mercury. Greenpeace has also accused the company of not protecting its workers from mercury spills.

Unilever has countered the accusations by suspending factory production while an operations audit and review of waste disposal procedures is carried out. The company says it will not resume production until officials there are satisfied that any environmental threat is mitigated and that waste disposal procedures are in effect to protect human health.



## GLOBAL WARMING

## The Soot Factor

A new computer model indicates that soot—blackened, unburned carbon—is a major factor in global warming due to the greenhouse effect, a fact that traditional global warming models have failed to take into account. Computer calculations by Mark Jacobson, an associate professor of civil and environmental engineering at California's Stanford University, have ranked soot second only to carbon dioxide (CO<sub>2</sub>) in overall global warming impact. The study, published in the 8 February 2001 issue of *Nature*, focused on how soot combines physically with other suspended particles in the atmosphere.

According to rough data compiled by the Intergovernmental Panel on Climate Change (IPCC), which produces worldwide scientific consensus statements on global warming, humans put about 11 million tons of soot into the atmosphere each year. About half comes from incomplete combustion of fossil fuels, and half from biomass burning (wildfires, which the panel considers nonanthropogenic, are excluded from the data).

Jacobson says most earlier models considered soot separately from other aerosols such

as sulfates (another product of combustion), soil, and sea salt, naturally put into the atmosphere by ocean waves. They also modeled soot in one condition or another; that is, they treated soot as not interacting with anything else, or as only one size distribution. In contrast, Jacobson studied 18 different size distributions that were interacting with other aerosols, such as sulfate.

This combining changes how soot affects solar radiation. In general, dark particles increase warming by absorbing solar radiation and reradiating it toward the earth. Light-colored particles reflect more radiation back into space, producing net cooling. Scientists call this effect of greenhouse gases "radiative forcing" and measure it in watts per square meter (W/m<sup>2</sup>); a gas that exerts a forcing of 1 W/m<sup>2</sup> will warm the earth as much as a 1 W heater placed over each square meter. Jacobson's is the first study to attempt a realistic prediction of how mixed soot would affect radiative forcing.

The study, Jacobson says, calculated the total radiative forcing of pure soot produced by combustion and of soot mixed with other aerosols as 0.55 W/m<sup>2</sup>. For comparison, the IPCC says the forcing of CO<sub>2</sub> is 1.56 W/m<sup>2</sup>, and of methane, 0.47 W/m<sup>2</sup>. Jacobson calculates that, taking into account changes in soot over time, each ton of soot causes twice

as much warming as calculated in previous estimates.

That finding is "probably legitimate," says Francis Bretherton, an emeritus professor of atmospheric science at the University of Wisconsin at Madison and a chapter author of the 1990 report *Climate Change: The IPCC Scientific Assessment*. "It's very plausible," he says, "although not unequivocally confirmed by hard evidence." Bretherton estimates that soot may contribute about 20% of overall greenhouse warming. He adds that, although Jacobson's results are another step in understanding the greenhouse effect, they should not divert attention from the major cause of global warming: CO<sub>2</sub> and the other greenhouse gases.

While soot may play a bigger role than expected in warming, it is more tractable than the greenhouse gases. Although CO<sub>2</sub> lasts for decades in the atmosphere, rain removes most soot within a week or two. And while CO<sub>2</sub> is an inevitable product of combustion, soot results from incomplete combustion, and efficient engines produce far less of it. Finally, unlike CO<sub>2</sub> or methane, soot exacerbates asthma and other diseases, so reductions could produce health benefits while reducing global warming. —David J. Tenenbaum

## RESEARCH INITIATIVES

## A Million Women Get Hormonal

In recent years, *one million* has come to be regarded as the critical mass for a show of support for social change, as evident in the many groups and marches whose names include that amount. In the case of the Million Women Study, however, the descriptor is not only apt, it's somewhat modest. In this British study 1.3 million postmenopausal women are participating in an unprecedented investigation of hormone replacement therapy (HRT) and its health effects. "There are very few epidemiological studies that include more than about 20,000 people," says Valerie Beral, co-principal investigator of the study, which is being coordinated by the Imperial Cancer Research Fund's Cancer Epidemiology Unit at the University of Oxford. "We have, over about a three-year period [1997–2000], recruited about 20,000 every month—it's like doing a standard epidemiological study every month for three years," she says.

The study is, in a word, ambitious. A primary goal of the Million Women Study is to investigate the breast cancer risk associated with HRT. Although many epidemiologic data exist on the link between breast cancer and HRT, results have been inconclusive about whether different types of HRT have different effects. Researchers with the Million Women Study aim to resolve that problem.

The researchers recruited women through the National Health Service Breast Screening Programme, which offers routine breast cancer screening for women in the United Kingdom aged 50–64. Through detailed questionnaires, the researchers collected data on HRT use and other variables such as diet, health and reproductive history, and alcohol and tobacco use. "As the largest study of its kind ever conducted, the Million Women Study has the potential to address a large number of research questions," says Emily Banks, a senior epidemiologist at the University of Oxford and the study's other co-principal investigator. "From the very earliest stages of recruitment, the enthusiasm women had for the

project was fantastic—the questionnaires were very carefully filled in, there were huge numbers of women keen to take part, and we had lots of letters and calls praising the study and asking the sort of questions the study is designed to answer," she says. Preliminary results from the first 121,000 respondents—primarily an overview of the study itself—were published in 1999 in *Breast Cancer Research*. Beral says further results will be made available as soon as possible.

But whether the Million Women Study will resolve the question of the role of HRT in breast cancer is open for debate. Despite efforts to guard against biases that have hampered previous studies—for example, HRT users being generally healthier than nonusers—Garnet Anderson, a biostatistician at the Women's Health Initiative Coordinating Center at the Fred Hutchinson Cancer Research Center in Seattle, Washington, says some biases cannot be prevented. "The many observational studies that have looked at the association of hormones and breast cancer . . . have left us confused because of inherent weaknesses in such studies," explains Anderson. "It is hard to know how yet another observational study, though admittedly a well-powered one, can clarify these areas."

Banks and Beral counter that they are taking into account known trouble spots in observational studies, factors such as self-selection bias and recall bias. They are planning studies to see whether these two issues will affect their results; the potential impact is currently unknown. Although the Million Women Study has the power, statistically speaking, to uncover small effects related to HRT, such effects could potentially be masked by uncertainty attributable to confounding factors.

Still, Anderson anticipates that the Million Women Study may shed new light on other exposures and some of the rarer hormonally related diseases such as colorectal, ovarian, and endometrial cancers. "When you have a million women and you can capture their health events over several years' time, you'll be able to see things that the smaller research programs could never dream of looking at," she says. —Julia R. Barrett



## Environmental Defense Scorecard: Environmental Justice

The struggle for environmental justice in the United States began to grow in the 1980s

when activists started fighting to end the inequities faced by residents of low-income communities, often minorities, many of whom bear a disproportionate burden of environmental health hazards. In February 1994 the environmental justice movement came to national prominence when President Bill Clinton signed Executive Order 12898, which focuses federal agency attention on this area of concern.

Environmental justice continues to grow in public awareness; today, news reports routinely focus on lawsuits and other efforts aimed at making neighborhoods safe from health hazards created by nearby chemical plants, factory farms, and waste disposal facilities. With public awareness has come public advocacy.

### Scorecard

In April 2001 the advocacy group Environmental Defense added an environmental justice section to its Environmental Defense Scorecard Web site. The new section is located online at <http://www.scorecard.org/community/ej-index.tcl>.

On the main Environmental Justice page, entering a ZIP code generates a report of the varying degrees of environmental burden within that area for different racial, ethnic, and income groups. The burdens include releases of toxic chemicals, cancer risk from hazardous air pollutants, and facilities emitting criteria air pollutants. These data are available for areas as small as a census tract, which can, depending on population density, be as small as a few city blocks. This is the first time that local-level environmental data have been analyzed for the entire United States to determine the environmental disparities experienced by different demographic groups.

Under the subhead Find Unequal Burdens is a link to a listing of all U.S. counties with possible environmental justice issues. Clicking on any name on the list brings up a summary report for that county with links to details about the distribution of environmental burden by demographic group. This report also includes locations of Superfund sites as part of the distribution of burden. Visitors can narrow down the master list by selecting a particular state, one or more environmental burdens, and one of seven demographic groups, including children in poverty, renters, working class people, families below poverty level, people of color, people without a high school diploma, and low-income families.

Each county report includes a link to the Environmental Justice Mapper feature, which generates an interactive map of the county showing the location of hazardous sites along with graphs of demographic data for various points on the map. Clicking on the symbol for a facility allows visitors to access an environmental release report for the site. The report details the facility's chemical releases and waste generation, ranks releases by the severity of their potential human health risks, sorts the releases into various health effect categories, advises on how to take action against toxic releases, and provides contact information for the facility.

Clicking on the Environmental Justice link back on the opening page takes visitors to an information page that provides a general background on the subject of environmental justice, a directory of pertinent community organizations, and links to federal programs that have been developed as a result of Executive Order 12898. These include the U.S. Environmental Protection Agency's Office of Environmental Justice, Office of Civil Rights, and National Environmental Justice Advisory Council. Under the Research heading on this page is a link to a list of studies conducted on health disparities, the various effects of living in close proximity to hazardous facilities, and regulatory enforcement and implementation activities. —Erin E. Dooley

## Maryland Frees Prisoners from Smoke

As of 30 June 2001 the State of Maryland made a move toward rehabilitation—*health* rehabilitation, that is—in its 25 correctional facilities,



when it banned all smoking for employees and inmates. Maryland's ban comes as a result of a federal lawsuit filed on behalf of a dozen nonsmoking inmates suffering from allergies, asthma, and heart diseases,

who contend that secondhand smoke violates their protection from "cruel and unusual punishment" under the Eighth Amendment of the U.S. Constitution.

Maryland correctional officials hope the ban will cut health care costs, lower the number of prison facility fires, and reduce the amount of illegal drugs finding their ways into the facilities. The state's 8,000 prison workers and 23,000 inmates will be offered access to smoking cessation programs.

## Vaporizing Dust Mites

Dust mites, microscopic creatures that grow in household materials such as bedding and carpets, feed primarily on dead particles of human skin. It is estimated that nearly 20 million Americans are sensitive to proteins in dust mite waste. Connecticut allergist



Jeffrey D. Miller investigated the properties of 56 plant oil vapors and found a number of them to be effective in killing dust mites.

Miller found wintergreen oil vapors to be the most effective, killing the pests in even large areas such as closets. Vapors of anise, lemongrass, pine, and spearmint were able to kill mites in smaller areas such as drawers and storage boxes.

In presenting his findings at the American Academy of Allergy, Asthma & Immunology 2001 annual meeting, Miller noted that the mite-killing properties of these vapors are probably a natural defense against mite infestations. He added that studies need to be performed to determine their clinical usefulness.