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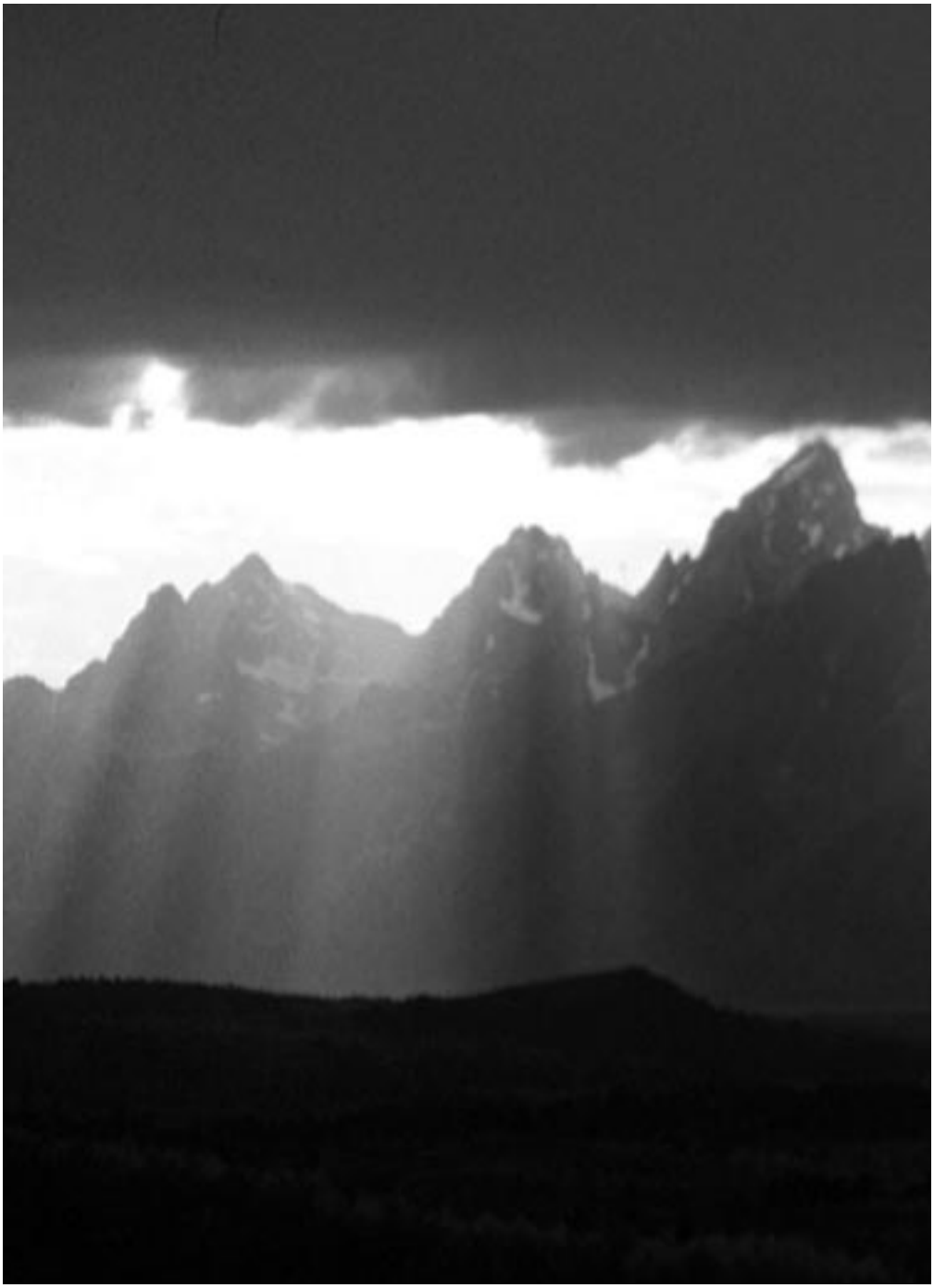
2003 Accomplishments Report



From the Deputy Chief

Our Nation's natural resources are absolutely essential to our health and quality of life. Forest Service Research and Development is constantly searching for better ways to sustain and protect those resources and to meet the needs of present and future generations.

It is within that broad framework that this report highlights—in six areas—some of our major accomplishments in the past year. They include the following:

- Healthy Forests—Led rapid response teams that gathered information that increased our knowledge of fire behavior and its effects, thus improving our abilities in fire suppression and wildland fire use management. We also launched the American Elm Restoration Project, which will restore sites with five American elm varieties that have a high tolerance for the Dutch elms disease fungus.

- Forest Inventory Analysis—Gathered more complete data on the United States. Such detailed data on forest trends are invaluable to sound scientific decisionmaking.

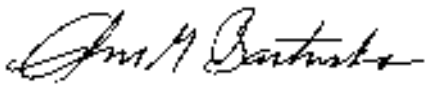
- Fish and Wildlife—Completed the experimental design for testing three treatment alternatives that can improve the habitat for wildlife populations and maintain forest health. Assessment of the effects of those treatments on plants, wildlife, and hydrology begins in the summer of 2004.

- Bioenergy—Used Forest Inventory Analysis data to assess available biomass in the Western United States, thus demonstrating that the National Fire Plan would result in about 350 million dry tons of accessible material in mechanical treatment areas.

- Urban and Community Forestry—Completed housing-density maps for 1940 to 2000 and projected them to 2030 across seven States in the North Central region.

- Forest Products Utilization—Developed low-cost filters from small trees for removing water pollutants. Cost difference is significant: The carbon filter we now use costs about $10, in comparison with $1 for the developed wood filter mat.

This report highlights the very best in science and knowledge that land managers can use. And it reflects the Forest Service commitment to science-based natural resource management. In large part, it reflects the legacy of my predecessor, Dr. Robert Lewis, Jr., who retired at the end of 2003. Robert leaves a solid foundation for Forest Service scientists and researchers to continue to address tomorrow's questions.



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Deputy Chief for Research and Development

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Healthy Forests: Working To Protect America's Forests from Fires and Nonnative Invasive Species

The U.S. Department of Agriculture (USDA) Forest Service and agencies of the U.S. Department of the Interior are making considerable progress in reducing hazardous fuels in forests and rangelands and helping communities prepare for wildfire. The fire research community has accelerated efforts to improve the science base of fire management, which forms the foundation for cost-effective and environmentally sensitive management of the wildfire hazard.

In addition to facing the hazards and consequences of wildfires, the Nation's forests confront the challenge of nonnative invasive species. An estimated 70 million acres of America's forests—about 10 percent of the country's forest lands—face the risk of extensive tree mortality from insects and pathogens alone. Nonnative invasive plants have additional impacts on ecosystems. Such threats to long-term forest health may jeopardize clean water, recreation areas, timber, and viable habitat for threatened and endangered species.

In confronting the challenge of invasive species, the Research and Development (R&D) scientists have focused on three specific problems that can cause great environmental damage: (1) *Phytophthora ramorum*, the pathogen causing sudden oak death in California; (2) Emerald ash borer, a beetle infesting and killing ash trees in Michigan and Ohio; and (3) Asian longhorned beetle, a large beetle found in and around New York City and Chicago.

Fire and Fuels

Wildfires have been a perennial environmental presence for millennia. In the United States about 67,000 fires burn about 2.7 million acres annually, and their occurrence has been increasing since 1980. During extreme fire years more fires burn greater acreage, with significant environmental, economic, and social impacts. Wildland fires continue to pose enormous risks to communities and the environment, raising concerns about declining forest-health conditions and increasing incidences of uncharacteristically severe wildland fires. Many of the most damaging impacts occur in ecosystems with historically frequent fires of low severity and where the absence of several fire cycles contributes to extreme fire behavior.

Importance

Research generates the tools and knowledge needed to maintain and restore healthy ecological landscapes. Therefore, R&D scientists seek to accomplish the following goals:

- Evaluate the effects and effectiveness of alternative fuel reduction and stand maintenance, restoration, and rehabilitation strategies.
- Improve modeling, monitoring, and prediction of fire weather, fire behavior, and smoke production and dispersal.
- Quantify fire severity and its effects of fire on plants, soils, air, and water quality.
- Quantify and model ecosystem health, structure, and change.
- Develop methods to manage insects, diseases, and invasive species.
- Develop methods to restore and maintain biological diversity.
- Work to understand and predict impacts of climate variability and change.
- Work to understand social and economic impacts of fire and fuel management strategies.

Accomplishments and Significance

Accomplishment: R&D scientists led rapid response teams to gather critical information from ongoing wildfires.

> **Significance:** Such information increases our knowledge of fire behavior and its effects, thus improving our abilities in fire suppression and wildland fire use management.

Accomplishment: R&D scientists and university collaborators used new satellite-monitoring capability in combination with improved aircraft-based, remote-sensing data, and data sets from a prototype landscape fuels-mapping project.

Significance: That capability provides fire managers in the northern Rocky Mountains with more accurate observations and predictions of fire behavior, effects, and perimeters.

Accomplishment: A new R&D protocol for evaluating and balancing effects of fire, both positive and negative, on natural resources and people is being used by national forests in Montana to develop guidelines for fire management plans and use in wildland fires.

Significance: R&D scientists now make new short-range to midrange fire predictions and provide fire-modeling tools that agencies can use to better anticipate firefighting needs, thus improving fire preparedness.

Accomplishment: R&D developed methods to help managers evaluate effects of treatments on fire behavior in stands and across landscapes, manage prescribed fires and wildfires, and analyze the costs and economic returns from alternative fuel-reduction scenarios.

Significance: R&D scientists report that prescribed fires are effective in reducing damage to southern pines when wildfires burn through treated areas.

Accomplishment: R&D developed uses for small-diameter trees and other biomass material removed from forests as part of the effort to remove fuels. New applications include a fiberboard product that uses low- or no-value material that could be obtained from hazardous fuels; low-cost water filters for streams; and the use of round wood in construction.

Significance: The use of small-diameter timber and biomass removals provide options for forest managers to make fuels management more effective and economical.

Looking Ahead

- Explore more integrated research approaches to understanding and predicting complex landscape processes and public response.
- Develop utilization strategies for excess biomass materials based on local conditions and capabilities, expediting fuels management around high-risk communities.
- Develop more advanced analytical tools, comprehensive models, and model validation, and new methods for communicating research results to others in the science, management, and policy communities.

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Nonnative Invasive Species: An Enormous Economic Burden

Nonnative invasive species present our Nation with one of its most significant environmental and economic threats. Global trade and travel fuel the movement of animals, plants, and micro-organisms across continents and oceans. Some of these species become serious problems, changing the ecology of our forests, fields, yards, and gardens.

An estimated 5,000 nonnative invasive species cost Americans an estimated $137 billion a year. The Forest Service alone spends more than $97 million a year to control the introduction and spread of such species.

Importance

Across North America, many invasive species have caused catastrophic damage to agricultural crops, urban and forest trees, and ecological systems, either by killing their hosts or crowding out native plants or crops. A major threat to biodiversity, these species have the potential to cause the extinction of domestic species such as salmon, Dungeness crab, and eastern white pine. In addition, nonnative invasive plants, such as cheat grass, are altering the natural fire cycle of plant communities and causing accumulation of fuels that may result in a higher risk for fires.

Accomplishments and Significance

Accomplishment: R&D launched the American Elm Restoration Project, which will restore sites with five American elm varieties that have a high tolerance for the Dutch elm disease fungus.

Significance: Planting American elm trees in forested landscapes where they can naturally regenerate enables trees to "co-evolve" with the Dutch elm disease and generate disease-tolerant trees. These trees will help retain the American elm and provide street trees for the future.

Accomplishment: R&D scientists developed a method for assessing plants for their invasiveness or potential to become invasive.

Significance: This method deals as aggressively as possible with potentially invasive plants before they become well established, minimizing their effects.

Accomplishment: R&D patented a less-costly, safer, and more effective biological control of the gypsy moth.

Significance: This control mechanism provides land managers, foresters, and pest-management specialists an effective control of the gypsy moth.

Accomplishment: R&D established colonies of two species of Chinese lady beetles that can be released to control hemlock woolly adelgid.

Significance: Colonies provide a biological, nonchemical control that can save remaining stands from the pest.

Accomplishment: R&D scientists identified a weevil from China that can attack the mile-a-minute weed.

Significance: The weevil provides biological control of the weed, responding to a tremendous challenge to forest and rangeland managers.

Looking Ahead

- Accelerate development and use of technology for surveying, inventorying, and monitoring invasive species.
- Expand work on controlling and managing invasive species.
- Enhance the establishment of disease-resistant strains of native species in the landscape.

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Sudden Oak Death: An Emerging Threat to West Coast Broad-Leaved Trees

Hundreds of thousands of coast live oak, California black oak, Shreve's oak, canyon live oak, tan oak, conifer seedlings, and shrubs have died as the result of infection by the pathogen *Phytophthora ramorum.* The effects of the disease were first observed in the San Francisco Bay Area in 1995, but the causal agent was not identified until 2000. Unfortunately, the spreading pathogen threatens our Nation's forest resources, urban landscapes, and horticultural economy. Sudden oak death (SOD) disease is well named, for the host trees usually die within several months.

Importance

Economically, SOD has major implications for forest and horticultural industries and small-fruit agriculture. Rhododendrons, a major horticultural specialty of the Northwest, potentially spread the disease. Because redwoods and Douglas firs are susceptible to field conditions in which the pathogen that causes SOD thrives, quarantines could result in a loss of an estimated $100 million a year for the redwood and Douglas fir industries in California alone. That amount will increase substantially if the disease occurs in areas other than California and Oregon. The possibility exists for enormous economic and ecological loss to the vast commercial Douglas fir forests in Oregon, Washington, and western Canada. Introduction of the pathogen to the eastern forests could be catastrophic.

Accomplishments and Significance

Accomplishment: R&D delineated infested areas in California, Oregon, and Europe, where aggressive containment through quarantine and eradication are under way.

Significance: This delineation approach holds a high probability of slowing the spread of SOD, which can be eradicated in small, localized infestations.

Accomplishment: R&D scientists developed a preliminary risk map integrating the possible methods of introducing the pathogen, the plant species most susceptible to it, and the weather conditions favorable to the development and survival of the disease.

Significance: R&D now knows that the southern Appalachian Mountains, the coastal areas of Oregon and Washington, and the uninfested areas of coastal California are at greatest risk for infection. Greenhouse and laboratory inoculation experiments indicate that seedlings of oak species common in eastern forests are susceptible to the disease.

Accomplishment: R&D developed a national strategic plan to control the introduction and spread of the disease by collaborating with two USDA agencies—Animal and Plant Health Inspection Service and the Agricultural Research Service—and with the Forest Health Protection program of the Forest Service State and Private Forestry (S&PF) deputy area.

Significance: This national strategy for addressing SOD generates sound management recommendations on symptom identification, sanitation measures, and quarantine compliance.

Looking Ahead

R&D will play an important role in implementing a national interagency strategy for managing and controlling SOD, seeking answers to the following research questions:

- What is the full range of potential hosts?
- How does the disease spread?
- What are effective treatment strategies?
- What are the short- and long-term ecological and economic effects of SOD?
- What epidemiological evidence enables us to predict disease spread?

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http://www.suddenoakdeath.org
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Emerald Ash Borer: A Nonnative Insect Poses Catastrophic Threat to North American Ash Trees

The female emerald ash borer (EAB) latches on to ash trees, laying its eggs deep inside bark cracks and crevices. The larvae burrow—and burrow. That tunneling activity can girdle a tree, killing it in 2 to 4 years.

Importance

In addition to causing significant ecological damage and loss of timber resources, EAB affects the tree nursery business through loss of sales and quarantines and increases the costs to States and municipalities for tree disposal and replacement.

R&D is studying the effectiveness of insecticides in killing EAB larvae and adults, determining proper disposal methods for infested trees and identifying the life history and spread of EAB.

Accomplishments and Significance

Accomplishment: R&D scientists developed methods for proper handling and safe disposal of infested logs, chips, and firewood to reduce the dispersal potential of EAB.

Significance: These methods help contain the spread of EAB.

Accomplishment: R&D developed scientific procedures for estimating dispersal of EAB adults, enabling regulators to delineate treatment zones.

Significance: Estimates of dispersal potential represent a major step in mapping treatment zones to stem the spread of EAB.

Accomplishment: R&D scientists tested the effectiveness of insecticides that kill EAB.

Significance: Such insecticides protect individual trees and help contain the spread of EAB.

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Asian Longhorned Beetle: An Aggressive Insect Threatening Hardwood Trees

Potentially the worst of the recently arrived ecological menaces to the hardwood forests of northeastern United States, the Asian longhorned beetle (ALB) devastates hardwood trees such as maple, birch, horse chestnut, poplar, willow, elm, and ash. One female ALB produces up to 160 offspring over its 10-week lifespan. A heavily infested tree usually dies in 5 to 7 years.

Importance

The Forest Service estimates the threat to urban-area trees at losses worth billions of dollars. In some rural areas, maple sugar production, fall foliage tourism, horticultural and fruit production, and timber are at risk. More importantly, broad-scale destruction of trees by ALB could have devastating consequences on our forests and forest ecosystems, including watershed and wildlife habitat. Should ALB expand beyond current quarantined areas, it could inflict serious damage throughout the Nation.

Accomplishments and Significance

Accomplishment: R&D developed a model that predicts the timing of all beetle stages, thus helping pest management specialists choose optimal times for eradication and preventive treatments.

> **Significance:** Detailed information on beetle development at different temperatures helped define the risks of beetles emerging from waste being moved from the New York City area to remote waste-handling locations.

Accomplishment: R&D demonstrated that ecologically safe parasitic nematodes, an alternative to pesticides, invade the ALB larvae and kill them.

> **Significance:** The nematodes provide biological effective control of this ecological menace.

Accomplishment: R&D scientists developed DNA markers to identify the origins of the beetles in North America.

> **Significance:** The DNA markers provide management technologies for ALB. That knowledge (and practice) would help control the spread of infestation in case eradication fails.

Accomplishment: R&D investigated flight patterns of adult beetles to determine the extent of their dispersal and the triggers of flight for food (among females) and for a mate (among males).

> **Significance:** The information provides more knowledge about this ecological menace, making it possible to better define the habits and characteristics of the beetle.

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Forest Inventory and Analysis

Forests cover nearly 750 million acres, or one-third of the land area in the United States. Knowledge of the extent, status, health, and trends of these forests is critical to developing sound management policies that ensure sustainable forest ecosystems. Since mandated by Congress in 1928, the Forest Inventory and Analysis (FIA) program has been the keeper of the ecological statistics, acting as a "family album" or census of these forests. FIA is the only program that collects, compiles, archives, analyzes, and publishes consistent State, regional, and national inventory information providing comprehensive inventory data for all forest lands in each of the 50 States, the District of Columbia, the Commonwealth of Puerto Rico, the U.S. Virgin Islands, the Commonwealth of the Northern Mariana Islands, the Trust Territory of the Pacific Islands, and the territories and possessions of the United States.

The FIA program partners R&D and State agencies, the National Forest System (NFS) and S&PF, other Federal agencies, and the National Association of State Foresters. The FIA program is integrated with NFS inventory and planning activities, and FIA data are available to support the National Forest Planning program. Partners contribute more than 20 percent of the total FIA program support.

R&D frequently uses FIA data to evaluate economic development opportunities, biological diversity status, and funding allocations for research.

Importance

The forest and related ecosystems of the United States are undergoing significant changes as a result of increased demand for, and use of, their finite resources by an increasing local, regional, national, and global population. Implementing FIA's new annual inventory strategy will help ameliorate this situation by providing an accurate, timely, and continuing assessment of resources across all landscapes. This information will help R&D better understand management options and provide guidance to ensure the productivity and sustainability of our Nation's forest ecosystems.

FIA research scientifically monitors and compares forests over time to chart changes. Much like the 10-year population census, birth, growth, death, and even immigration (exotic or invasive species) are all woven into the Nation's ecological history and recorded for analysis. FIA data are commonly used in the following:

- State and national measures of forest health and sustainability.
- Measures of timber harvest and utilization.
- Ownership patterns and objectives on private forest lands.
- Trends in forest cover, fuel loads, and biomass.
- Trends in forest composition and structure.
- Spread of invasive species in forest landscapes.
- Trends in protected forest ecosystems.

Accomplishments and Significance

Accomplishment: R&D gathered nearly complete data on the United States.

Significance: Such data provides detailed information on forest trends, grounding forest decisionmaking in science.

Accomplishment: R&D completed the FIA National Database and interactive Tablemaker, Mapmaker, and data applications.

Significance: These data tools improve significantly customer access to FIA data.

Accomplishment: R&D implemented a new privacy policy to protect the integrity of FIA plot locations.

Significance: This policy ensures data privacy for landowners, enabling FIA to collect more data on their land and populate the Nation's land-management database with accurate information.

Accomplishment: R&D developed computer models to help estimate fuel loads and assess fire risk.

Significance: The models provide more timely information to public and private land managers.

Accomplishment: R&D produced more than 100 publications, papers, and media products providing current information on State, regional, and national resource situations, including updated national statistics for 2002.

Significance: Publications provide timely access to scientifically reliable U.S. forest resource information.

Looking Ahead

- Obtain full funding to expand annual average coverage to all forest lands. Currently, FIA has obtained 82 percent of full funding for complete implementation.
- Complete implementation of the forest health monitoring component of FIA in all States to characterize forest health and provide regional trends annually.
- Develop new or improved techniques that support efficient and effective inventory and monitoring on a continuing basis. Continue to develop capabilities for remote sensing and integration with the Geographic Information System (GIS).
- Develop new, more accurate maps of national forest covertype and biomass/fuels based on satellite imagery and FIA ground-truth data.
- Work with NatureServe and other Federal and State agencies in developing a National Vegetation Classification System compliant with the Federal Geographic Data Committee.
- Develop improved methods of communicating information consistently and effectively to managers, policymakers, and the public in a variety of formats. Multimedia, GIS, the Internet, and other communication tools can be used to deliver products to the public and clients.

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Fish and Wildlife

Wildlife populations respond quickly to environmental changes; they are sensitive indicators of forest health. At a broad scale, declines in amphibians, some migratory birds, and some raptors have been early indicators of pollution and habitat conversion. At a local scale, species declines are associated with increases in invasive weeds and wildlife diseases, overgrown or overstocked forest, habitat conversion and fragmentation, and recreation overuse. Restoring healthy wildlife populations requires an understanding of the key processes leading to the declines and a correction of the underlying habitat problems. The resulting healthy forests and rangelands are not only more productive for wildlife, but help us better meet our need for timber, water, and air.

Importance

Research on fish and wildlife fosters ecologically sound management activities. Understanding the reaction of wildlife species to habitat changes enables R&D
to minimize negative effects of management activities and maximize positive effects. For instance, minor changes in the pattern of wood removal may make a large difference in habitat quality for species that require tree clusters for denning or nesting. R&D efforts result in using more precise conservation measures such as leaf strips around streams and seasonal restrictions on motorized recreation. R&D efforts also define more precisely the critical habitat for threatened or endangered species.

Accomplishments and Significance

Accomplishment: R&D completed the experimental design for testing three treatment alternatives.

Significance: Such assessments enhance the habitat for wildlife species and identify treatments that can better maintain forest health and wildlife populations.

Accomplishment: R&D documented how invasive woody plants changed wildlife communities of dry riparian areas and worked with cooperators to remove and treat woody invasions. Studies also focused on factors that exacerbated weedy invasion, its effects on wildlife, and its control.

Significance: Such documentation informs forest plans and management decisions.

Accomplishment: R&D used landscape-scale habitat modeling to describe the effects of habitat fragmentation resulting from land conversion and to minimize its effect on key wildlife species.

Significance: This modeling enhances interaction with managers in defining key habitat types and areas for species of concern.

Accomplishment: R&D studied the impact of off-road recreational vehicles (ORVs) on nesting raptors and began a major assessment of ORV use patterns and their effects on wildlife in California.

Significance: Such research evidence guides forest plans and management decisions.

Looking Ahead

- Integrate wildlife studies with vegetation dynamic models to better describe the effects of management alternatives (for example, thinning patterns, prescribed burning, grazing, and timber harvesting) on wildlife species of concern.
- Work with the NFS to establish protocols and patterns for monitoring and data analysis to ensure compliance with legal requirements.
- Study ORV impacts, especially on ground-dwelling vertebrates such as reptiles and amphibians.
- Work with the NFS to establish priorities for invasive weeds research that acknowledges the costs (wildlife habitat, human aesthetics, and fire risk) of invasive species and the potential for controlling these species.

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Bioenergy

The USDA Forest Service investigates how forests can provide renewable sources of energy. An estimated 1.2 billion dry tons of nonmerchantable forest residues are available for use, and mill byproducts offer another 90 million dry tons per year. Enhanced use of small-diameter trees and nonmerchantable residues, additional recovery of manufacturing byproducts, and efficient fast-growing plantations can provide the feedstocks to increase significantly bioenergy supply. The use of biomass for energy, if properly integrated into management systems, can be both an economical and environmental asset.

Unfortunately, cost forms the primary barrier. Compared with fossil fuels such as coal and gas, the price differential is more than 2 cents per kilowatt hour—a substantial amount. Even as a "green" substitute, not many customers are willing to pay such a large extra amount for energy.

Technical and cultural barriers also exist. Generally, Americans prefer readily available energy from a pipe or a pump and do not care for inconvenience. Many prefer that forests provide nonconsumable products and resist using the forest as an energy resource and using plantations to replace large amounts of even marginal farmlands.

Importance

The use of renewable energy can reduce the buildup of greenhouse gases and greatly enhance U.S. energy security by reducing dependence on offshore fossil fuels. Through research, we can reduce the economic, technical, and cultural barriers and provide substantial and sustainable resource and conversion systems
to provide both transportation fuels and electrical generation at competitive costs.

Accomplishments and Significance

Accomplishment: Using FIA data, R&D assessed biomass in the Western United States, demonstrating that the National Fire Plan would result in about 350 million dry tons of accessible material in the required mechanical treatment areas.

Significance: Nonrenewable energy sources such as coal, petroleum, natural gas, and similar fuels provide about 75 percent of electricity production and about 94 percent of other energy needs in the United States. The United States has consumed more than 80 percent of its proven oil reserves and imports more than 60 percent of its oil at a cost of more than $75 billion. Only 6 percent of U.S. energy consumption comes from renewable sources, with biomass providing about 50 percent of that share.

Accomplishment: R&D evaluated new technologies for cost-competitive stand treatments for reducing fuel loadings and using them as sources of bioenergy.

Significance: New technologies reduce treatment costs of fuel loadings and enhance competitiveness.

Accomplishment: R&D led the genetic development of fast-growing trees for short-rotation plantations.

Significance: Such advances provide an economical and environmental asset that makes energy readily available.

Accomplishment: R&D tested small-scale technology in converting biomass to materials for local use.

Significance: This new approach provides the knowledge and technology to improve the economic feasibility of using small-diameter materials, forest residues, solid wood and paper wastes, and short-rotation wood for bioenergy feedstocks to increase the use of forest biomass for energy and increase U.S. energy security.

Looking Ahead

- Develop management systems and technologies to produce, recover, and use forest biomass for bioenergy at an affordable cost.
- Improve wood waste and conversion processes to increase bioenergy potential.
- Provide short-rotation woody cropping systems to increase unit area productivity and reduce harvesting and transportation costs on a per-unit basis; develop technologies for economically processing that resource.
- Develop integrated production and management systems that produce high-value products and bioenergy feedstocks.
- Participate in the International Energy Agency programs on bioenergy feedstock production.

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Urban and Community Forestry

Urban and community forestry (U&CF) no longer focuses simply on planting street trees; it has become an essential and highly valued component of numerous large-scale, long-term environmental and community sustainability projects. Urban and community forests improve environmental quality, enhance individual and community well-being, provide a range of services to communities, and produce a healthier environment for most of the U.S. population. The R&D's U&CF program responds to those needs for more than 70 million acres of America's urban and community forest resources.

The program strives to accomplish the following goals:

- Provide technical and financial assistance.
- Strengthen USDA Forest Service and State leadership in the care of urban and community forest resources.
- Increase transfer of technical information.
- Increase awareness and education about the importance of healthy urban forest resources.
- Promote volunteerism and citizen participation.
- Ensure urban greening efforts are biologically sound and sustainable.

Because important connections exist between the quality of life in metropolitan areas and land use associated with sprawl, a strong economic case can be made for conserving green open space to guide growth and revitalize city centers and older suburbs. One step in that direction is charting changes in housing density, as has been done in the North Central United States.

Importance

U&CF produces housing-density maps that help scientists identify where land fragmentation occurs and that facilitate the estimation of impacts on wildlife, increases in fire risk, and other resource management concerns.

Accomplishments and Significance

Accomplishment: R&D's U&CF program completed housing-density maps for 1940 to 2000 and projected them to 2030, across the seven-State North Central region: Illinois, Indiana, Iowa, Michigan, Minnesota, Missouri, and Wisconsin.

> **Significance:** These housing-density maps help the Forest Service reconstruct past patterns of residential-housing density, as well as project and map trends.

Accomplishment: R&D's UC&F program developed computer software: ecoSmart FireWise.

> **Significance:** The software facilitates sound decisionmaking on growing, removing, or pruning trees to enhance fire safety around users' residences in wildland-urban areas, while considering ways to enhance site beauty, retain native vegetation, and ensure privacy. In the United States, more than 40 million homes are located at the wildland-urban interface, putting them at risk from fires moving in from nearby forests.

Looking Ahead

- Develop housing-density maps and identify implications for natural resource management in other regions.
- Develop software for estimating the impact of strategically placed vegetation on stormwater runoff (WaterWise) and energy use (EnergyWise).

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Forest Products Utilization

The United States ranks fourth in the world in forested lands and uses far more forest products than any other country. Between 100 million and 200 million acres of America's Federal lands are at risk for wildfire, disease, and insect attack from overstocking. Although part of that risk can be reduced by carefully executed "controlled fires," at least 30 million acres will require mechanical removal of excess understory trees before regaining forest health.

Forest Service R&D helps manufacturers, mills, small business operators, and small log markets become more efficient and environmentally sensitive by identifying cleaner and more efficient processes for product conversion and by developing procedures for producing better-performing wood products.

Forests in the recent epoch (the past 10,000 to 15,000 years) have evolved under the influence of humans and natural fire. Well before the last glaciers receded from North America, indigenous people had harvested timber and used fire for thinning and land clearing to meet their need for shelter, hunting, gathering, and protecting their communities. In the arid West, where moisture is too scarce to support fungal decay, fire sparked by lightning is the primary mechanism for cleaning dead trees and limbs from the forest floor. Climate factors, widespread wildfire suppression (a national priority since 1910), and now-discredited forest management activities over the past 75 years have contributed to overgrown conditions in many forests that now require active management to repair.

An additional source of danger looms in the introduction of exotic and invasive pests and diseases to the world's forests by global transportation. Active and sometimes intensive emergency management often is needed to save or mitigate the losses of forests to these invasions.

Importance

Unlike treatments for maintaining health in humans, the cost of maintaining forest health must be paid with revenues from the sale of materials removed from forests. Without utilization of forest resources, it would take billions of Federal dollars, a workforce and equipment not currently available, and disposal methods that might threaten State environmental compliance to make a dent in the problem. Although the current and potential uses for wood seem limitless, a shortage in demand for and value of small-diameter and low-value trees exists in many parts of the country. The interior West, where the need to remove such trees is among the greatest, has one of the lowest capacities for using forest products.

Unfortunately, the technologies and the economic incentives for using these small-diameter trees are minimal, and the cost of transportation often exceeds the market value of the material. Research and development are needed to identify new utilization options for small-diameter timber, such as development of value-added products and bioenergy.

Accomplishments and Significance

Accomplishment: R&D developed low-cost filters from small trees for removing water pollutants.

> **Significance:** Most filtration systems are expensive. Local fuel loads are converted into fibers for making low-cost filters. Using such forest biomass can help meet management objectives on public lands and contribute to resolving many important environmental issues facing our country.

Accomplishment: R&D demonstrated structural uses for low-grade hardwoods such as red maple.

> **Significance:** Hardwoods, generally underutilized, now can be used to make high-quality lumber economically.

Accomplishment: R&D used ultrasonic methods for grading and sorting pallet parts.

> **Significance:** This approach provides a more accurate method for quantifying and sorting those parts and getting the most efficient use of the wood.

Accomplishment: R&D linked forest ecology and end products to support management alternatives.

> **Significance:** End products provide alternative uses for hazardous forest fuels.

Looking Ahead

Forest Service R&D can contribute to President George W. Bush's Healthy Forests Initiative, the National Fire Plan, and the Biomass Research and Development Act of 2000 (Pub. L. No. 106-224). The agency can help answer the following questions:

- How can research extend the economical use of biomass from small-diameter trees?
- How can research improve rural environments and economies through renewable wood energy?
- How can the management of the Nation's forests be further improved by better utilization?
- How can forest biomass be used to reduce U.S. dependency on foreign oil?

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