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Biological Research on Fire in the West

Background

Wildland fires are a natural feature of many ecosystems, including grasslands, forests, and shrublands. However, years of fire exclusion have led to accumulations of dead fuels and increases in the density of fire-intolerant species. In most western states, recent fires burning in these altered ecosystems have caused significant damage and huge economic losses to homes, businesses, and communities. They also have disturbed forests and rangelands as well as their associated watersheds, plants, and animals. Every western state is concerned about damage from such catastrophic fires, and there is strong interest from all sectors in preventing and reducing the resulting damage in the future. There also is interest in the use of fire as a management tool for reducing hazards and restoring damaged ecosystems and for returning fire to its natural role in wilderness ecosystems.

USGS Fire Science Capabilities

- Fire Effects
  - ▷ Terrestrial ecosystems
    - Invasive species
    - Forest and rangeland health/ecology
    - Fuel treatments
  - ▷ Aquatic ecosystems
    - Watershed health
    - Aquatic ecology/fisheries
- Fire History and Climate Change
  - ▷ Plant community shifts
  - ▷ Fuels mapping
  - ▷ Fire patterns over time
  - ▷ Modeling
- Fire Rehabilitation, Restoration, and Monitoring
  - ▷ Treatment options/techniques
  - ▷ Monitoring protocols and indicators
- Fire in Urban Interface Areas
  - ▷ Fire-prone ecosystems
  - ▷ Fuel treatment options

The USGS has fire-science capabilities and currently conducts research and provides technical assistance for federal, state, and local agencies. The USGS not only addresses the immediate support needs of agencies and communities, but also supports long-term research including the ecological and social effects of wildland fires, and restoration and rehabilitation activities. Although fire plays a significant ecological role in natural communities, economic and ecological damage can be severe in ecosystems that have been significantly altered. USGS biological research focuses on historical and contemporary roles of fire in western ecosystems in an effort to understand how to best manage fire for the benefit of humans and natural resources.

The work of USGS scientists complements the efforts of other federal and state agencies, local governments, non-government organizations, and private-sector interests, all concerned with fire and fire effects. The results of USGS research and associated science information should contribute to the President's Healthy Forest Initiative, the national 10-Year Comprehensive Strategy for Reducing Wildland Fire Risks, the priorities of the Western Governors' Association on wildland fire and forest and rangeland health, and the national interagency Joint Fire Science Program. The following stories represent a few of the many projects the USGS is conducting related to fire.

Fuel Accumulation in Conifer Forests

In some western states, more than 100 years of excluding fire has led to a heavy build-up of fuels such as dead vegetation, dense brush, and dense tree

stands, as well as a shift to species that have not evolved with or adapted to fire. These conditions, combined with drought, have caused many fires to be larger, burn more intensely, and spread more rapidly than before the fire-exclusion era. USGS scientists in the Sierra Nevada have just completed a 10-year study to determine fuel accumulation rates for the species that occur in mixed conifer ecosystems: giant sequoia, ponderosa pine, sugar pine, Jeffrey pine, incense-cedar, white fir, and Shasta red fir. They also related annual increments of fuel to stand characteristics. Such relationships allow predictions of fuel loadings to be made on a stand basis for each of these species under current and possible future conditions. The amount of fuel deposited annually is one determinant of fire regimes, specifically fire-return intervals and the natural range of variability in fuels loads. For example, ponderosa pine forests, which accumulate flammable litter at a high rate, sustain more frequent fires than white fir forests, which have a lower rate of fuel accumulation and burn less frequently. Given the same lightning ignition and fire weather patterns, the two species produce different fire regimes, including the period between fires, their intensity, and their areal extent.

Invasion of Annual Grasses

Large portions of the rangelands of Nevada, eastern Oregon, and southern Idaho, once dominated by sagebrush and other native shrubs, grasses, and herbaceous plants, are being replaced by exotic and invasive annual grasses following major wildfires. Exotic grasses have invaded many regions of the west, including the Great Basin, the Mojave and Sonoran deserts, the Sierra Nevada, and California's coastal chaparral. These grasses are typically Eurasian annuals that perpetuate fires on a nearly annual basis, threatening human communities, wildlife, and traditional ranching practices. Such rapid fire cycles are having a significant impact on the native communities of plants and animals that often have few evolved defenses against fire and are unable to survive frequent successive burns. USGS researchers are conducting detailed studies to better understand how increased fire size and frequency affect arid ecosystems of the west, how fire changes nutrients in the soil, how invasive plants and fire are related, and how to protect native plants and animals from further impacts of invasive annual grasses.

Urban Expansion at the Wildland Interface

Throughout the western United States, human communities continue to expand and blend into natural communities dominated by forests, grasslands, or shrublands. The latter is the case on the coast of California where an increasing number of communities are being developed in adjacent shrublands called chaparral. This development is not without risk, as California chaparral ecosystems burn in large landscape-scale crown fires that are necessary for the ecology of these systems but pose a threat to human populations. USGS research shows that many species in these systems are highly dependent on recurrent fire because some seeds require smoke to induce germination. Unlike western forests where a century of fire exclusion has led to fuel accumulation and a risk of catastrophic wildfires, USGS research has shown that large, intense fires have burned in chaparral ecosystems for numerous decades. They occur, in league with powerful Santa Ana winds, as frequently today as before widespread fire management aimed at fire exclusion. USGS research is providing critical information about the ecology and natural history of these ecosystems to advise land managers about appropriate fire management policy in shrubland-dominated landscapes. For example, unlike other plant communities, the use of prescribed fire in these areas is not necessary for ecosystem health, nor is it able to prevent large-scale fires.

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