Urban Forest Research

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Center for Urban Forest Research • Pacific Southwest Research Station • USDA Forest Service

What We've Learned

Fire Prevention in the Wildland–Urban Interface

Trouble in Paradise

For many people tired of the hassles of city life, a home in the wildlands is the answer. More and more people are choosing to leave the cities to seek open spaces, clean air and water, trees and wildlife, and smaller communities. But this idyll setting is not without its troubles.

Although people come to rural communities with the best of intentions, they bring along some of the problems of urban life. They also encounter issues unique to the places where city meets country—the wildland-urban interface.

In the U.S., 42 million homes are located in the wildland-urban interface. With these homes come roads that fragment the landscape, pollution, invasive plants, domestic animals, and other accompanying changes to the wildlands.

The large influxes of people we're seeing are creating a hybrid environment—part urban and part wildlands.

One of the biggest challenges to this new and expanding environment is the threat of wildfire. Increased population causes increased ignitions which, in turn, can result in more fires. A growing awareness of this danger has many communities actively seeking solutions.

Vegetation cover of a tightly spaced coniferous stand.

Setting the Scene of Our Research

Over the last 150 years, wildland areas have changed in critical ways. A policy of fire suppression has played a large part in these changes. Without fire, these areas have become crowded with dense vegetation that is less healthy due to competition for water, nutrients, and sunlight. The frequent surface fires that were common under natural conditions prevented this fuel buildup.

Drier climatic conditions have added to the stress on trees. Insect infestations and other diseases have taken their toll, adding to the number of dead and dying trees in the forest. When fire does occur, there is more fuel to burn, creating potentially catastrophic conditions.

Firefighting is complicated at the wildland-urban interface because of differences in techniques and equipment used in cities versus wildland settings. In the cities, firefighting is focused on saving structures and people within. Wildland fires are fought at the landscape scale. Topography, weather, and other characteristics of fire behavior are the key factors.

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With the increased population in the wildlands, however, suppression has become more critical than ever for saving lives and property. We no longer have the luxury of letting wildfires burn.

Finding solutions to the threat of fire in the wildland-urban interface is difficult at best. There are not enough firefighting resources to protect the homes and lives there, or to address the increasing threat. With traditional solutions limited, those involved in protecting the public from wildfire have had to explore new directions.

Today, more responsibility is put on individual landowners and communities to protect themselves. This is often accomplished by using fuels modification, or pre-fire treatments.

"New" Defensible Space

Creating defensible space, the practice of modifying vegetation around structures to minimize the danger of ignition, is often the first step taken to protect homes. Many states and communities have defensible space ordinances that require fuel clearances of a stated distance around structures.

In California until January 2005, the law required a 30' clearance around structures. That distance was recently increased to 100' because 30' was found to be inadequate in many situations.

Unfortunately, there is no one-size-fits-all solution when it comes to defensible space. While 30' at least allows fire trucks to maneuver, in areas of heavy fuels or steep slopes 100', 300', or even more may be required to successfully minimize fire danger.

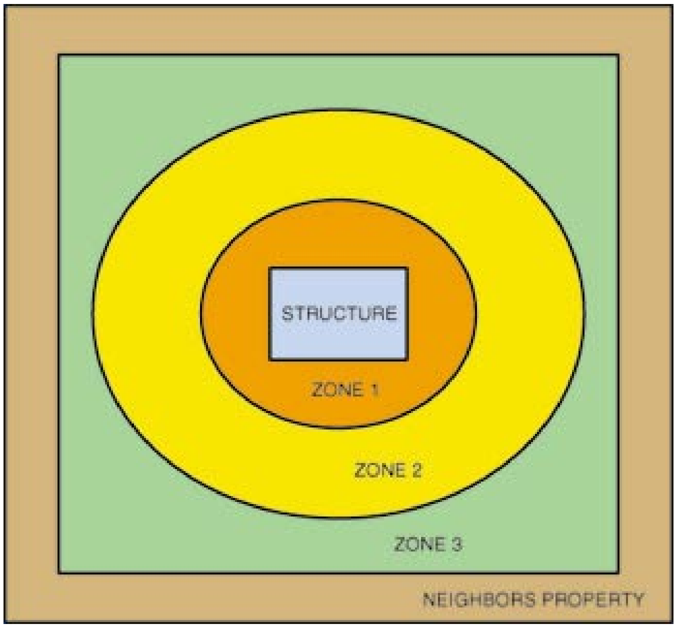
Landowners may be understandably reluctant to make such severe modifications to their landscape. They move to wildland areas to enjoy the natural environment, not to change it. In addition, there may be concerns that privacy, wildlife habitat, appearance, disposal of treated vegetation, erosion, water quality, and other attributes of the wildands may be compromised through such treatments.

Rather than simply extending the distance for defensible space, most fire professionals now talk in terms of zones. Zone 1 is the area immediately surrounding the structure; it is usually cleared of all flammable vegetation. Zone 2 is an area beyond Zone 1 where vegetation is modified to remove continuous fuel while still retaining aesthetics and functional values. In Zone 3, vegetation is left generally in its natural state. The zones concept can be adapted to an individual property, with landowners working with the vegetation rather than taking a scorched-earth approach.

Structural Choices

Another piece of the equation is the construction and design of structures. The most vulnerable parts of a home to fire are 1) the roof; 2) vents, eaves, and windows; and 3) decks.

It is possible to decrease the risk of fire by using materials that are less flammable, and designing or retrofitting homes to minimize some of the weaknesses of the structure. Roofing material, in particular, should be non-flammable. Eaves and vents have important functions in minimizing moisture damage, so there are tradeoffs that need to be made. Constructing fire resistant homes is an important,



When building defensible space around a structure think in terms of zones.

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but often overlooked, part of the discussion.

A Balancing Act

Making a home or community more fire safe requires tradeoffs—it's a balancing act that must take into consideration a number of personal values and objectives including land use, aesthetics, building materials, views, privacy, wildlife habitat, vegetation, economics, and more. The continuing research that others are doing on fire behavior, defensible space, structural fire resistance, wildlife response, and other topics will help provide better answers.

Two Case Studies

Studies were undertaken by our Center to evaluate hazardous fuels treatment projects in the communities of Shingletown, CA, and Incline Village, NV. The studies looked at several aspects of the projects: collaboration process, costs, potential savings, accomplishments, and lessons learned.

While fuel treatments alter forest structure and modify wildfire behavior and severity, there has been little scientific evidence demonstrating whether the treatments make economic sense. Ecological forest benefits and loss include timber and nontimber products, range and forage, fresh water, flood protection, terrestrial and aquatic habitat, wildlife, recreation, scenery, and carbon sequestration. Community benefits and loss include property damage and revenue losses.

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Send comments or suggestions to Jim Geiger, Center for Urban Forest Research, Pacific Southwest Research Station, USDA Forest Service, c/o Department of Plant Sciences, Mail Stop 6, University of California, 1 Shields Avenue, Suite 1103, Davis, CA 95616-8780 or contact jgeiger@fs.fed.us.

Fuels treatment is intended to reduce the likelihood of extreme fire behavior, to lower fire suppression and postfire costs, and produce less smoke, less property damage, and fewer lost socioeconomic and ecological forest benefits.

The effectiveness of fuels treatments are rarely tested by actual wildfires. Instead, fuel models are used to estimate the benefits and costs of these activities.

Shingletown

Shingletown is a rural community in northern California with approximately 8000 residents and 2800 housing units. The community is located along 20 miles of a ridgeline at 1500-4500' elevation.

Vegetative cover around Shingletown is primarily mixed conifer with a chapparal understory. There are large areas of continuous, heavy fuels on the forest floor, largely caused by historic logging and successful fire suppression activities over the past hundred years. The result is a high to very high fire hazard rating throughout the area. In addition, this area has more lightning strikes per acre than anywhere else in the county. The homes and businesses that are clustered within this vegetation are extremely vulnerable to wildfire.

Slash pile for pickup during the annual community firesafe program.

Fuels being chipped and hauled to the co-generation plant.

Crews working on a shaded fuelbreak in commercial timberland.

The Shingletown fuels treatment program started modestly in 1992 with community cleanup days around individual homes.

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It has expanded into a Fire Safe Plan covering over 110,000 acres with multiple projects each year. In 2003, the Shingletown Wildfire Defense Plan included 10 hazardous fuels reduction projects, 14 roadside shaded fuelbreaks, and 7 other action items to improve fire-safe conditions in the area.

The success of the program is largely due to the high level of public participation. Initially, extensive time and effort were spent on education, involvement, and implementation of the fire safe program for the area.

Incline Village

Incline Village is located in the Lake Tahoe basin and supports a population of almost 10,000 people and 7,674 housing units. The community ranges from 6,200 to 7,500' elevation with steep slopes generally greater than 30 percent.

Most of the homes in Incline Village are built on ridgetops with greenbelt land located in the drainages below. Prior to the 1990–92 hazardous fuels treatment project, the greenbelts consisted of overstocked coniferous forest stands and riparian habitat. About 700 acres of the greenbelt are now owned and managed by the Incline Village General Improvement District (IVGID).

Incline Village exists in a high fire hazard condition. There is historical evidence that large, catastrophic fires occurred there. Altered plant communities and fuel conditions, along with 20th century fire suppression policies, have affected the natural fire regimes. Areas that formerly burned with high frequency but low intensity now have large accumulations of unburned fuels. In addition, a drought in the late 1980s caused pest infestations and high tree mortality, resulting in fuel buildup that could cause a catastrophic fire.

The Board of the IVGID decided to remove fuel buildup in their greenbelt to help protect the community. The greenbelt, with its overstocked forest stands and high tree mortality on steep slopes, provided a good demonstration area for appropriate projects.

Because of proximity to the Lake Tahoe basin, IVGID needed to design the project to minimize environmental impacts while considering economics.

An initial 20-acre test plot was treated by thinning the stand, removing the ground fuel buildup and pruning the remaining trees. Based on this work, the Board agreed in 1990 to fund a large-scale project that included timber harvest and treatment of the remaining hazardous fuels.

The 1,000-acre project was carried out using helicopter logging, piling and burning. Extensive community education occurred and partnerships were developed prior to beginning the project. Prescribed burns were later implemented on treated lands for ongoing maintenance.

Lessons Learned

Many of the lessons to come out of these two studies involved working with community. Some of the key points and suggestions include:

- Community involvement was the most important factor for success of the programs. Knowledge of the community, working with community leaders, and cooperation were vital.
- Education was necessary to convince residents that there is a problem.

Helicopter removing logs from project area.

Prescribed fire being re-introduced in earlier treated IVGID lands.

A partion of the project area after treatment.

- Stakeholders must be involved early and throughout the process.
- It is important to provide ownership and a sense of responsibility to community members rather than imposing projects from the outside. Successful projects were ones where the community was provided the freedom to develop/implement a program with the agencies used as a resource.
- Demonstration projects were crucial to show how treatments would look on the ground.
- The most successful efforts were those where local agency leaders had good relationships within the community, cared about the program personally, communicated well and knew how to acquire needed resources..
- Community projects are a long-term investment. Education, cooperation, and partnerships require ongoing commitment with continued maintenance.
- Provide recognition and reward residents for their hard work.
- When working on sensitive projects, have someone available to answer concerns and questions quickly. Be willing to modify projects based on these concerns.
- Find time to research existing information, think of solutions, and look for new partnerships.
- Have a dream of what could be and a vision of what it would look like.

New Wildland Interface Software

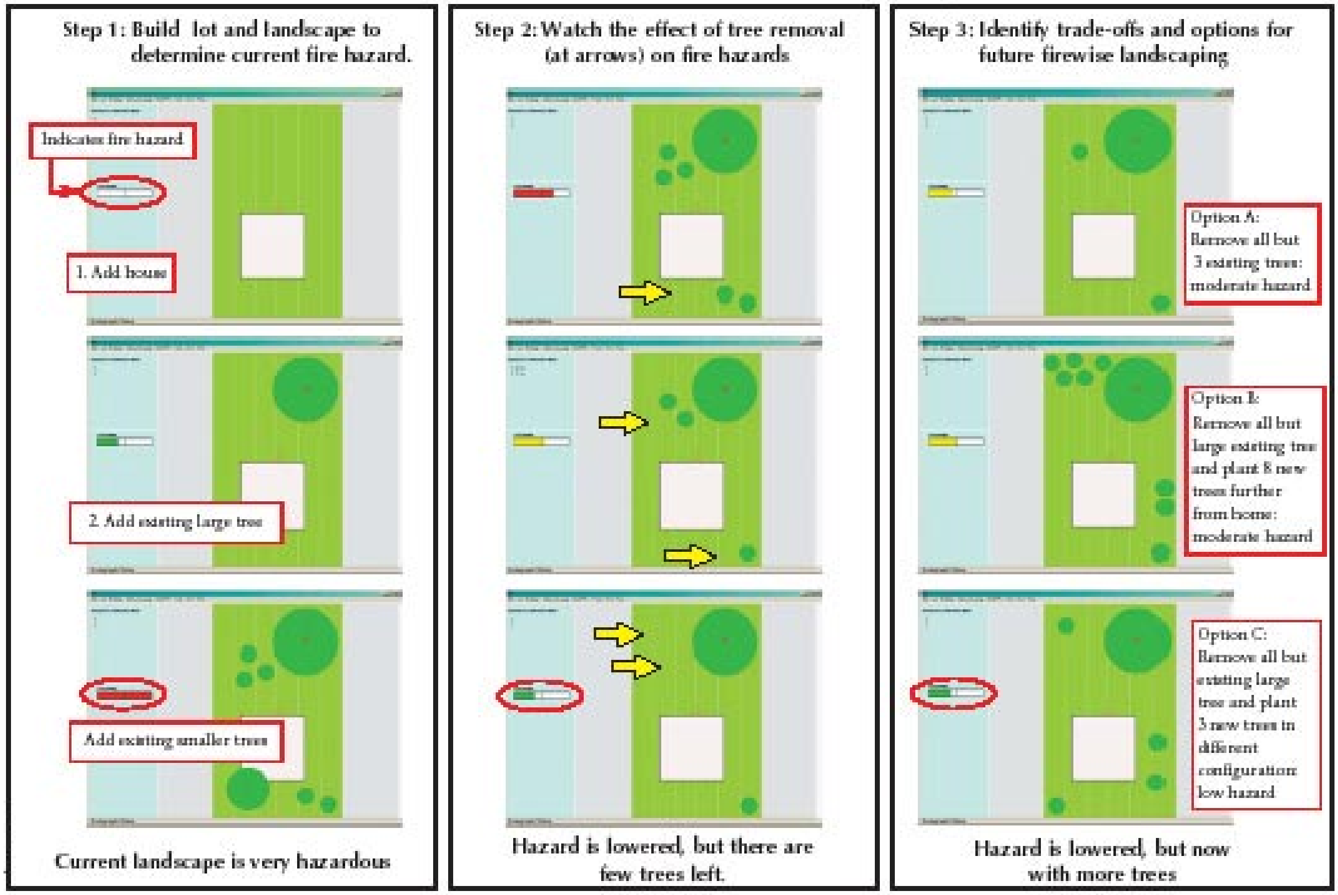
Our Center has developed new software, ecoSmart-Fire, that can help with decisions to decrease fire hazards. It is an interactive, flexible, graphical tool designed to help residents make fire safety choices while considering ways to enhance beauty, retain native vegetation, ensure privacy, conserve water, and save energy.

ecoSmart-Fire allows landowners and land managers to try out various scenarios on the computer. While the software is based on complex fire physics, the user simply tests various alternatives.

- Remove trees and shrubs, change species, or reduce ladder fuels.
- Clean roofs, change roof material, add double-pane windows, add non-flammable siding, change decking material, close in eaves, add irrigation, move woodpiles *(coming soon)*.

ecoSmart-Fire is free and available at http://www.ecoSmart.gov.

ecoSmart-Fire software calculates fire hazard given various scenarios.


Step 1: Build lot and landscape to determine current fire hazard.
Indicates fire hazard
1. Add house
2. Add existing large tree
Add existing smaller trees
Current landscape is very hazardous
Step 2: Watch the effect of tree removal (at arrows) on fire hazards
Hazard is lowered, but there are few trees left.
Step 3: Identify trade-offs and options for future firewise landscaping
Option A: Remove all but 3 existing trees: moderate hazard
Option B: Remove all but large existing tree and plant 8 new trees further from home: moderate hazard
Option C: Remove all but existing large tree and plant 3 new trees in different configuration: low hazard
Hazard is lowered, but now with more trees

Announcing the View from the Top

Regional Urban Forest Canopy Cover Analyses

First-of-its-kind report

Coming Spring 2006 is our first regional canopy cover analysis of an urban forest in the San Francisco Bay Area. Subsequent reports are planned for other California regions and beyond. Imagine being able to quantify the value of the ecosystem services for an entire regional urban forest.

The driving force behind these analyses, in particular the San Francisco Bay Area, is the rapid growth that many of our most populated regions are experiencing. This growth accelerates air pollution, water and energy demand problems. And as you know, these problems need solutions.

Urban forestry is integral to many public services such as land use planning, mitigation of water shortages, conservation of energy, improvement of air quality, and enhancement of public health programs. The goal of this study is to describe the region's urban forest structure and quantify the value of ecosystem services it produces. This information will help communities understand the relevance of regional urban forest impacts to the environmental and economic health of Bay Area communities, and the potential return on investment in planning and management.

Deliverables

1. ***Historic canopy cover change*** for the nine county region will be displayed based on Thematic Mapper (TM) data for 1984, 1995, 2002. Also, we will map change in impervious (rooftops, paving) and pervious (turf, bare soil) land cover for these periods. In the final report, tabular data will list our findings for each city and county.

2. ***The value of annual benefits produced by the current tree canopy*** will be mapped and listed for each city and county using higher resolution ASTER imagery. To obtain estimates of kWh of electricity saved, tons of ozone uptake, etc., and to place a value on tree benefits, the region will be divided into 5 climate regions and three tree zones that correspond with our reference city data collected in San Francisco, Berkeley, and Modesto. Canopy will be stratified by land use (residential, non-residential developed, park developed, other, forest land).

3. ***The value of future tree canopy*** will be determined using projected land development, urban growth, tree planting, and conservation levels.

4. ***Benefit-cost tables for typical large, medium, and small trees*** will be produced as a reference for designers, planners, and managers. The 40-year stream of annual benefits and costs will be listed for each 5-year interval after planting.

Preliminary Findings

What we found so far is that the population has increased 30% in the nine-county Bay Area from 1980 to 2000. During that time, the urban built environment has increased 73%, from 1,620 square kilometers (625 square miles) to 2,800 square kilometers (1,080 square miles).

Using the current urban area boundaries as defined by the 2000 Census for analysis, we studied how land cover has changed with urbanization from 1984 to 2002. Canopy cover has increased within this area by 10% and impervious surfaces have increased by 17%. Urban expansion has been primarily into rangeland and agricultural areas. This has had the effect of increasing canopy cover but the increase in canopy cover has not kept pace with the increase in impervious surfaces. The increase in impervious surfaces between 1984 and 1995 was almost double that of canopy cover.

Conclusions

The urban environment in the San Francisco Bay Area has rapidly expanded into predominately rangeland and agricultural areas. A population increase of 30% has driven a 73% increase in urban area. The increase in urban area is associated with increased canopy cover, but this 10% increase has not kept pace with the 17% increase in impervious surfaces. This was especially true between 1984 and 1995 when impervious surfaces increased nearly twice as much as canopy cover. With the exception of San Jose, the pattern of urban growth or increase in urban extent has been in areas outside the immediate vicinity of the San Francisco Bay.

What's next

The next phase of the project will calculate the benefit and cost per canopy cover area for the entire San Francisco Bay Area. We also hope to expand this effort beyond California in the near future. Stay tuned.