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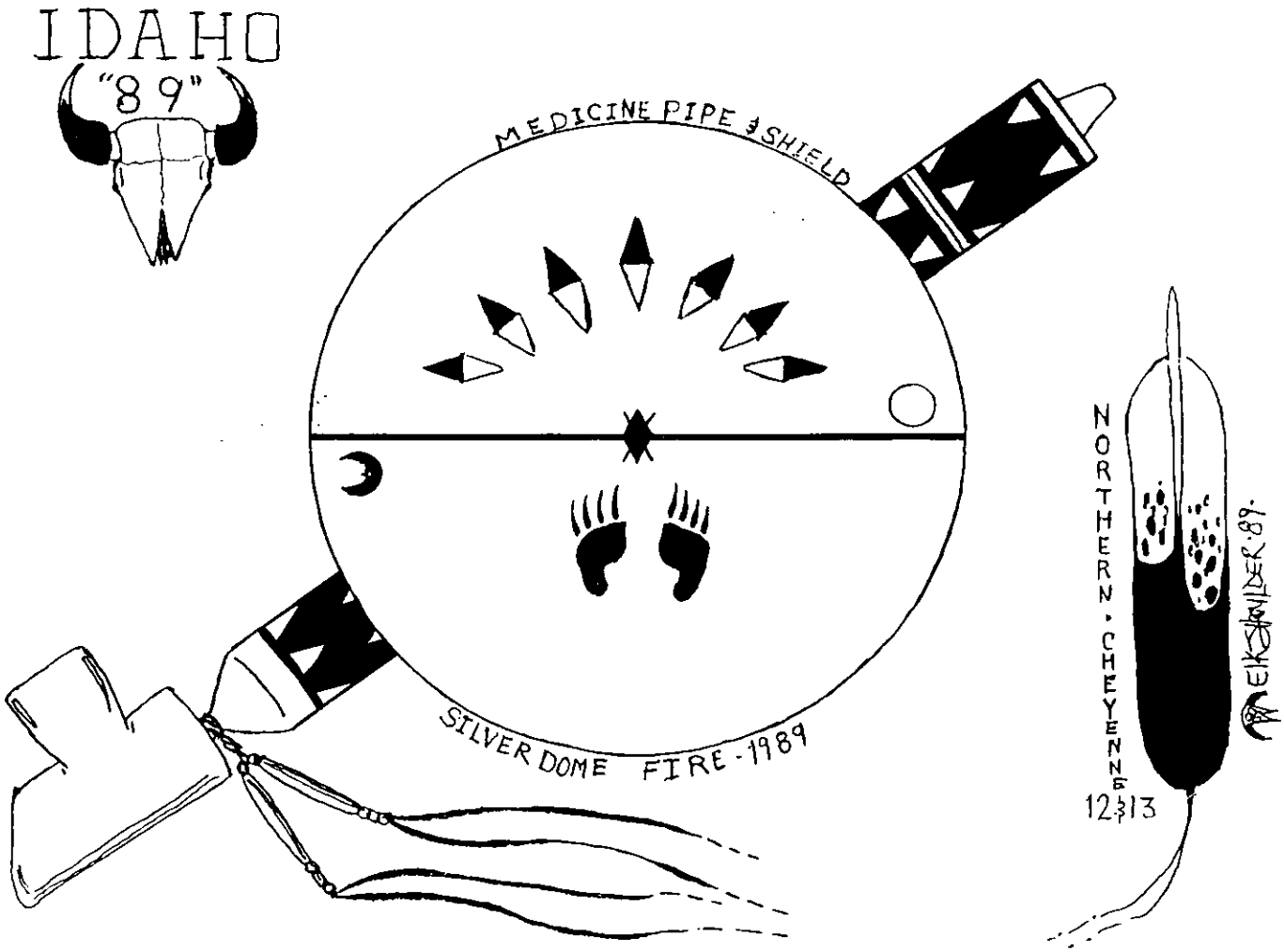

Fire Management Notes

An international quarterly periodical devoted to forest fire management

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Short Features:

Front Cover: Silver Dome Fire shift plan cover, designed by Mark Elkshoulder, Lame Deer, MT, a member of the Northern Cheyenne No. 12 firefighting crew.

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Wildland Fire in the 1990's: Problems, Solutions, and Priorities as Seen by Fire Managers

Clinton B. Phillips and Charles W. George

Fire management consultant, California Fire Safe Consultants, Grass Valley, CA,[1] and project leader, USDA Forest Service, Intermountain Research Station, Missoula, MT

Here are some recommendations for remedial action in the eight most important problems expressed by fire managers in a survey of Federal, State, and local wildland fire protection agencies.

Surveying Fire Managers

Late in 1988, the USDA Forest Service's Fire Suppression Research Work Unit (RWU) in Missoula, MT, surveyed 260 fire managers from Federal and State wildland fire protection agencies throughout the United States. The RWU's objective was to have the fire managers identify and prioritize their fire suppression problems.

In this survey, we listed 14 potential fire suppression problems (obtained from recent analyses of fire research needs) (Paul and Thatcher 1988, Rice and West 1987), asked fire managers to name additional problems, and requested that they rank them all from most important to least important. Responses from 135 fire managers provided both a ranking of the original 14 problems plus an additional 25 problems. Although the list was established collectively by the responding fire managers, there were important differences among agencies and geographical areas as well as among respondents of any one agency or geographical area—an expected outcome. All 39 problems identified during the survey, regardless of their priority, are important to at least some fire managers and, therefore, are worthy of examination and solution.

From the total of 39 fire suppression problems, we selected the 8 ranking highest, paired the problems in 28 ways, and used them to construct a second survey that was mailed to 123 fire managers in early 1989. We used the mathematical technique of "ratio scaling" (Davis 1987) in this survey—the fire managers had to divide 100 points between each pair according to their own priority for solving the two fire problems. Finally, we tabulated, mathematically processed, and analyzed the responses (see Phillips 1989 for a more extensive report on this survey). The results of the survey are summarized in the accompanying box.

Additional Concerns of Fire Managers

In addition to setting priorities for solving fire suppression problems, fire managers expressed four basic concerns (in one or both of the surveys):

- Many, if not most, current fire suppression problems are related to

Results of the Ratio Scaling Survey

In 1989, 123 fire managers used "ratio scaling" (Davis 1987) to establish the following priorities for solving their fire suppression problems:

Priority	Problem description	Normalized priority score
1	Communications systems and equipment still need improvement and expansion	155
2	Standards must be strengthened for training and equipping firefighters to cope with all emergency situations at the wildland-urban interface	145
3	There is a continuing need to refine the Incident Command System and to expand its use in a standardized manner to all fire protection agencies (equal rank with following problem)	127
3	More and better alternatives of fire suppression strategies and tactics are needed at the wildland-urban interface (equal rank with preceding problem)	127
5	Better ways are needed for managing the overwhelming flow of information and data	122
6	Barriers of laws and policies must be removed in order to improve interagency cooperation and coordination (equal rank with following problem)	112
6	There is a need to review and design new firefighting tools and techniques for use at the wildland-urban interface (equal rank with preceding problem)	112
8	There is a need for better descriptions and measures of the fire suppression problem at the wildland-urban interface	100

[1]Mr. Phillips, now retired, formerly was Assistant Deputy State Forester of the California Department of Forestry and Fire Protection.

the increasing number of wildfires involving both structure and wildland vegetation. These fires at the "wildland-urban interface" are the driving force behind many recent changes in all aspects of wildland fire protection systems nationwide.

- Many important fire suppression problems have their roots in organizations, policies, and budgets rather than in lack of knowledge of suppression techniques and practices.
- There is a continuing need for all fire suppression organizations to move closer together. Barriers must be removed so all suppression agencies understand each other's functions and mode of operation, can cooperate in the consolidation of facilities where necessary, can find ways to accommodate differences in fiscal and personnel management procedures, and can work together in conducting interagency training. "Trust" is a keyword.
- Although many fire suppression problems are rooted in organizational differences, there are still problems that require new knowledge before they can be solved. Researchers and equipment engineers can continue to play important roles by discovering new knowledge about fire suppression as well as by improving current tools and techniques.

Recommendations

Administrators of wildland fire management agencies are urged to recognize the stated problems and make every effort to solve them expeditiously. Potential solutions may seem blocked by constraints of budgets, too few qualified personnel, task priorities, and social and political realities. Nevertheless, managers must somehow remove these blocks and achieve progress through interagency cooperation and coordination.

Because the survey is at least 2 years old, some of the problems may have been partially or wholly solved. The development of METAFIRE, for example, now enables fire managers to predict the probability of large wildfires up to 2 days in advance with excellent accuracy (Simard and Eenigenburg 1991). Despite that important breakthrough and other additions to the knowledge of fire management, we feel the results of our survey are still valid and useful and that, for the most part, the problems still need to be solved.

Following are some recommendations for remedial action on the eight most important problems and also on four additional problems expressed by responding fire managers (table 1).

Priority Number 1: Communications systems and equipment still need improvement and expansion. Present communications systems are often inadequate, especially when a large number of agencies and ground and air firefighting resources are involved in the suppression of major or multiple wildfires. A working team of the National Wildfire Coordinating Group (NWCG) should take a new look at the reasons why fire managers continue to identify communications as their highest priority problem. They should study communications systems and equipment in all Federal, State, and local wildland firefighting agencies because of the increasing interdependence of these agencies on each other's resources.

Definitions

Our definition of wildland-urban interface is taken from "Wildfire Strikes Home!" (Laughlin and Page 1987):

Classic Interface—Homes press against wildland vegetation along a broad front.

Mixed Interface—Homes and other structures are scattered throughout wildland vegetation in rural areas.

Occluded Interface—Isolated areas of wildland vegetation fall within an urban area.

The working team must determine what needs to be done to upgrade existing communications systems and equipment by taking these actions:

- *Analyzing the communications requirements* under varying conditions. (For example, questions such as the following need to be asked: What equipment is needed when there are a variety of participating agencies and resources? Does the topography require special equipment? What is the best system to use when there are multiple wildfires in the same area?)
- *Establishing communications alternatives and standards* that will satisfy the requirements.
- *Looking at existing communications systems and equipment* in the context of the requirements and standards and developing new or revised systems and equipment where necessary.

Finally, the working team should be charged with recommending solutions to this high priority problem.

Priority Number 2: Standards must be strengthened for training and equipping firefighters to cope with all emergency situations. This problem seems highly complex, but

it has a common denominator: Increasingly, firefighters from all agencies (Federal, State, and local) work together on wildfires, are more dependent upon each other's resources, and must attack fires in both wildland vegetation and structures. Fire managers therefore see a growing need for commonality and standardization in training, qualifications and certification, and equipment. The Incident Command System (ICS) (discussed below) is one step toward that standardization, but other steps are needed—and quickly.

This huge problem could be solved most expeditiously by an interagency working team, probably under the guidance of the NWCG. Membership on this team would include (at least) a fire manager, equipment engineer, trainer, and systems analyst who would identify all elements of this problem and recommend remedial actions. The working team would define standards for training and

Table 1—*Summary of fire managers' problems, recommendations for solution, and suggested assignment*[1]

Problem (in order of priority)	Short description	Recommendation	Suggested assignment for solution	Probability of successful solution
1	Communications	Make total systems analysis of problem	NWCG Working Team	High
2	Standardization in training and equipping firefighters	Make total systems analysis of problem	NWCG Working Team	Very high on training; low on equipment
3	Incident Command System	Agency heads need to rededicate to ICS; fine-tune system	NWCG ICS Working Team	Very high
3	Alternatives in tactics and strategies	Study characteristics of the wildland-urban interface or intermix	Fire Suppression RWU	Very high
5	Coping with information and data flow	Organize a library of available computer programs and develop new programs where needed	NWCG ICS Working Team	Very high
6	Barriers of laws and policies	Interagency committee should recommend needed changes	NWCG Working Team	High
6	New tools, techniques, and staffing standards	Determine needs for changes in equipment and staffing standards to cope with fires at wildland-urban interface-intermix	Fire Suppression RWU	Very high
8	Describe changing fire problem at wildland-urban interface-intermix	Define fuel loading, fuel models, effects of weather on those models and on fire behavior; give this problem high priority	Fire Suppression RWU and other INT RWUs	Very high
Additional	Update fire detection systems	Investigate application of infrared, video, ALDS, LORAN, and other equipment	Equipment Development Centers, contractors, and Fire Suppression RWU	Very high
Additional	Update maps used in fire suppression operations	Expand use of orthophoto and GIS maps and imagery as well as use of infrared downlinks	Agency administrators	Low, depending on budget priorities
Additional	Improved short- and long-term fire weather forecasts	Maintain pressure for improved fire weather forecasts	NOAA weather researchers	Low, depending on budget priorities
Additional	Needs in fire behavior and fire danger models	Develop needed models	Fire Behavior and Prescribed Fire RWUs	High

[1]NWCG = National Wildfire Working Group; RWU = Research Work Unit; ICS = Incident Command System; INT = Intermountain Forest and Range Experiment Station; ALDS = Automatic Lightning Detection System; LORAN = Long-range navigation; GIS = Geographic Information System; and NOAA = National Oceanic and Atmospheric Administration.

equipping firefighters from all agencies to cope more effectively with the increasing complexity of wildfires at the wildland-urban interface. Especially needed in training and equipment are:

- More rigidly and uniformly enforced standards of qualification and certification of firefighters.
- Standards of firefighting resources.
- Cross-training and equipping of wildland and structural firefighters to a practical degree.
- Training of all firefighters in the use of modern technical equipment and techniques.

Changes in both ground and aerial firefighting equipment might require 10, 20, or more years. However, commitment to defining standards and making changes should be made now.

Priority Number 3 (First Problem): There is a continuing need to refine the Incident Command System and to expand its use in a standardized manner to all fire protection agencies.[2] The ICS is gaining popularity throughout the United States, not only among firefighting agencies but other emergency-response organizations as well. However, the ICS is still not used in fire suppression by all fire protection agencies throughout the United States, and where it is used, it is not applied in a standardized manner. As occurs so often with anything new, the ICS can be and often is modified locally. Unfortunately, such local changes usually result in confusion and ineffectiveness when a major interregional emergency involves firefighters from farflung geographical areas. Fire managers are therefore calling for more rigidly enforced standards of using the ICS while recognizing that, even at this early date in its development, the system needs some fine-tuning. Agency heads must commit themselves and their organizations to this common system that can benefit everyone if used in a standardized manner. One of the best ways to achieve that standardization, fire managers say, is to increase interagency training, not only in the ICS but in all aspects of fire management.

The ICS Working Team of the NWCG can solve some of these problems by ensuring that the system changes in the following ways:

- Expands and makes use mandatory among all fire protection agencies in all States and at all governmental levels.
- After reviews, refines and improves the system to allow its use in a broader range of emergency situations and conditions.
- Builds in flexibility but, at the same time, requires standardized use by all agencies.
- Provides for more interagency training, including regular interagency field exercises.

At the same time, members of NWCG need to rededicate themselves to the ICS as will, we hope, their agency heads; they must insist on interagency standardization of system use. All is not well out there in the real world, say the fire managers, and they want early remedial action.

It is becoming increasingly difficult for fire managers to cope with both the spread of wildland fires and having to protect structures like these at the wildland-urban interface (see Priority Number 3, second problem).

[2]Two problems ranked third in level of priority.

Priority Number 3 (Second Problem): More and better alternatives of fire suppression strategies and tactics are needed.[2] This problem received mixed reactions among agencies and geographical areas. Overall, however, fire managers say they are increasingly unable to cope with both the spread of wildland fires and having to protect structures at the wildland-urban interface. They ask: What are the proper mixes of ground and aerial resources to cope with both wildland and structural fires? What are the strategies and tactics that will best protect the lives of residents as well as prevent injuries and deaths to firefighters? What precautions should trained wildland firefighters take to protect themselves against the effects of hazardous materials encountered around structural fires?

Fire managers are concerned that wildland residents aren't doing enough to protect themselves from encroaching wildland fires. These residents build homes with fire-prone designs and materials; locate homes on high-hazard sites that are difficult to reach along narrow, twisting, steep roads; fail to identify either the roads or homes by installing proper signs; don't provide supplemental sources of water to help protect their properties; and fail to clear flammable vegetation to provide a defensible space around structures. "How do we motivate property owners to do more to protect themselves?" ask wildland fire managers who are more comfortable with combating fires burning in grass, brush, or timber than those burning in structures.

Continuing research is needed to identify the changing wildland-urban fire complex and to answer the above questions. There is a need to determine the hazardous materials that firefighters are most likely to encounter during a wildfire at the wildland-urban interface and to incorporate safety measures into firefighter training. Existing guidelines for fire safety around structures and communities need to be collected, collated, and made more readily available to all fire managers in all agencies. Then, fire managers can work together with local governments and communities to enforce fire safety in all its aspects.

To enable the Incident Commander to cope more effectively with the growing complexity of fire suppression at the wildland-urban interface, more and better alternative strategies and tactics need to be developed, including at least:

- Suppression of the spreading wildfire while simultaneously protecting lives and structures.
- Proper mixes of wildland and structural firefighting resources.
- Consideration for the safety of firefighters and the general public.
- Enforced standards of fireproofing around structures and other places of habitation.

Priority Number 5: Better ways are needed for managing the overwhelming flow of information and data. The Incident Commander needs better ways to manage the overwhelming volume of information and data that must be received and transmitted during a major wildfire, including having ready access to improved computerized programs, models, and displays.

This problem elicited a mixed response, depending on local experience. Here are some typical remarks:

- "The ICS is great and we wouldn't want to be without it, but the system certainly generates a storm of paper! Can't the reports be reduced in number or content?"
- "The Incident Commander spends more time on the radio or telephone than fighting the fire. How can this time be reduced?"
- "Computers are becoming a big help, especially on major conflagrations. Many computer programs assist the management of wildfires, and others need to be developed. However, there isn't any central library or distribution point for these programs to assist fire managers of all agencies. What can be done?"

Solutions to these problems include:

- As part of the overall fine-tuning of the ICS, both the amount of paper work required and the communications demand on the Incident Commander and his or her staff during a wildfire should be reduced.
- Fire managers from all agencies should be canvassed to find computer programs to help manage all types and sizes of wildfires. Researchers working with fire managers should determine the need for additional programs, develop them, and make them available to all potential users, using *Fire Management Notes* as the informational medium.
- The NWCG should establish an interagency central library to distribute fire suppression computer programs. One option might be to look at services offered by the Forest Resources Systems Institute

(FORS) (Dippon and Cooney 1988). Since this problem is related to the ICS, it probably should be assigned to the ICS Working Team of the NWCG.

Priority Number 6 (First Problem): Barriers of laws and policies *must be removed in order to* further improve interagency cooperation and coordination in the suppression of wildfires.[3] Restrictive laws, regulations, and policies that interfere with interagency cooperation must be identified and analyzed and either removed or modified to the greatest degree possible.

This problem was rated at about the same level by all groups of responding fire managers. The stated differences among agencies contribute to operational difficulties in wildfires, especially those involving a unified command under the Incident Command System. They also contribute to problems on interagency fires when dealing with contractors, vendors, and casual pickup labor. And they are factors in affecting morale, the ultimate reflection of which is the increasing movement of trained and valuable firefighters from one agency to another because of disparities in such areas as salaries, benefits, and working conditions.

There is probably no practical way of completely solving this problem. Still, another comprehensive look might be taken to identify where differences exist, where commonality can be achieved, and what steps can be taken to change laws and regulations that constrain interagency operations. Such a study can best be undertaken by an interagency working team of the NWCG.

Priority Number 6 (Second Problem): There is a need to review and design new firefighting tools and techniques.[3] Because of the increasing complexity of fire suppression operations at the wildland-urban interface, the overall arsenal of firefighting tools and techniques needs to be reviewed to determine what new, improved, or more cost-effective designs can be provided. The following topics should be included:

- Continued studies to establish standards for foam and other fire retardants and to determine the best equipment to apply them.
- Identification and development of the next generation of air tankers and helicopters.
- Engines and other resources designed to suppress wildfires involving a mixture of both wildland vegetation and structures.

Several fire managers commented on the need to establish standards for such aspects of foam fire retardants as wetability, penetration, and time of effectiveness under a broad spectrum of fire suppression and weather conditions and for both ground and aerial application. Others stated the need for improved and standardized equipment for both air and ground application of foam. The Forest Service's Fire Suppression RWU's current Operational Retardant Evaluation (ORE) Project should provide many of the answers to this part of the problem.

Other fire managers saw the need to reevaluate the cost and effectiveness of air tankers and helicopters on initial attack and mop-up operations. They also felt that navigational equipment such as NAVSAT and LORAN should be mandatory on all aircraft used on major wildfires where vast areas of smoke make it difficult for the pilot to locate landmarks from the air.

Several fire managers recognized the unique character of the rapidly expanding wildland-urban interface or intermix and the need to design engines and other equipment to suppress wildfires burning there. Engines, they say, must be designed to suppress wildfires burning in both wildland vegetation and structures. One fire manager recognized that large line-building equipment, such as bulldozers, may not always fit into the narrow confines of some wildland-urban interface areas and that it might be appropriate to take a fresh look at line-building equipment like trenchers and flailers. Such equipment might also be more acceptable to the concept of "light hand on the land" than the heavier track-laying equipment.

There is a need to study the broader picture of firefighting resources that would perform most cost effectively under a variety of fire behavior situations at the wildland-urban interface, relate that need to the current arsenal of resources, and determine the characteristics of new resources that should be developed. Included would be staffing standards that should be recommended and adhered to by all wildland firefighting agencies. The success of suppression activities depends largely on the production rates of individual firefighting resources; those rates are affected

[3]Two problems ranked sixth in level of priority.

strongly by staffing levels. Without adherence to staffing standards, it is difficult for Incident Commanders to accurately plan and execute the all-important task of wildfire containment.

Because this problem includes many facets of wildfire suppression, we recommend it be assigned initially to the Fire Suppression RWU of the Intermountain Forest and Range Experiment Station (INT) for further review and study. That RWU would then reassign specific aspects of the problem to appropriate research and equipment groups.

Priority Number 8: There is a need for better descriptions and measures of the fire suppression problem. The increasing mixture of structures and wildland vegetation presents a broad spectrum of fuel complexes that are not yet well described, measured, or related to fire suppression requirements. Specific needs are the following:

- Better descriptions and measures of fuel models and loading.
- The effects of varying weather on those models and the resultant measures of fire danger.
- Measures of fire behavior that may be expected under varying conditions of fuel, weather, topography, and fire suppression operations.

Although most fire managers, collectively, rated this problem low in the second survey, certain groups treated it with more respect. Fire managers from State agencies other than California and from both Federal and State agencies in the Midwest and Northeast rated it as their fifth priority. Many fire managers, especially those facing an increasing number of wildfires at the wildland-urban interface, saw the solution to this problem as basic to the solution of most other fire suppression problems.

This problem should be addressed as soon as possible because its solution would affect so many other fire suppression problems. It probably should be given a higher priority than most fire managers indicated. We recommend that the problem be assigned to the INT Fire Suppression RWU for initial study and possible reassignment to other RWU's at the laboratory.

Additional Problems

Although not directly related to fire suppression, the following problems were among those expressed by fire managers as requiring early solutions:

Update Detection Systems. Several fire managers commented on the need to update and upgrade wildland fire detection. Several possibilities were suggested:

- Replace human lookouts with electronic equipment such as infrared or video. What would be the comparative cost and effectiveness of such electronic equipment? Could the equipment be designed to detect small wildfires, to transmit that detection immediately and efficiently to the dispatcher, to provide enough additional information to help the dispatcher make well-informed decisions about initial attack, and be programmed to differentiate between known "friendly" fires in contrast with wildfires?
- Improvement in the location, density, and use of the Automatic Lightning Detection System (ALDS).
- Use of LORAN and NAVSAT or similar navigational equipment to enable aerial detectors to provide instant coordinates of wildfires to dispatchers.

Such studies should probably be planned and conducted by the Forest Service's equipment development centers or by contract to appropriate vendors. Ultimately, a systems analysis of wildland fire detection might be in order to determine the most cost-effective mixture of fire detection modes.

Update Maps. A few fire managers expressed the need for up-to-date maps such as those prepared from orthophotos or Geographic Information Systems (GIS) that would provide more detail than U.S. Geographical Survey topographic maps. Also, during multiple fires, fire managers need better, real-time maps of the overall fire situation, possibly from down-linked infrared detectors. These maps are available now, but to a very limited extent. They should be expanded as quickly as budgets and priorities will permit.

Another recent innovation that may prove valuable is the automated mapping system, Topologically Integrated Geographic Encoding and Referencing (TIGER). This new system is currently available from the U.S. Census Bureau on magnetic tape only but may be released soon on compact laser discs.

Fire Weather Forecasts. Many fire managers are frustrated by the continuing unreliability of fire weather forecasts, both short-term and long-term. Answers to questions such as "How do I locate and install

a fire weather monitoring network in the most cost-effective manner?" or "What should be the density of stations in situations with different terrain, microclimate, and values at risk?" may be available but not well distributed to fire managers. These and related questions have been asked for at least 20 years. Currently, researchers are working toward answers. For fire managers, we can only recommend patience. But don't stop pressuring!

Fire Behavior and Fire Danger Models. Many fire managers said they need the following:

- More and better local fuel models for the National Fire-Danger Rating System.
- More and better fire spread models for predictive planning, including microscale models for small parts of a large fire.
- The BEHAVE program to include extremes of drought, wind, and fuel loading, and the effects of those extremes on fire suppression tactics and safety.
- Information on the short- and long-term effects of prescribed burns on the behavior of wildfires in different fuel models.

These and related questions could be addressed by the Forest Service's Fire Behavior RWU or Prescribed Fire and Fire Effects RWU.

Conclusion

If the continuing destruction by wildfires of natural resources, lives, and property is to be mitigated, both administrative and research organizations must work to find solutions. Improvement of fire suppression operations is obviously one important aspect of that mitigation. ■

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Meet Your Feet!

As every experienced wildland firefighter knows, good boots and proper foot care are essential to being able to do the job successfully. But that knowledge has often come the hard way—hot, tired feet; blisters; and occasionally, missed days on the fireline because of foot problems.

To help new firefighters (and maybe a few experienced ones, too) do a better job of selecting work boots and caring for their feet, the USDA Forest Service's Missoula Technology and Development Center (MTDC) has recently issued a new video entitled "Meet Your Feet." Designed to reduce the incidence of foot problems among forest workers, the video covers boot selection—including fit, cost, soles and care, foot care and hygiene, and types of socks.

"Meet Your Feet" can be purchased for $18.33 per copy from

Teknifilm, Inc., 909 NW 19th, Portland, OR 97209; telephone (503) 224-3835; or limited "loaner" copies can be obtained from MTDC. For more information on "Meet Your Feet" or an earlier companion video "Wildland Walking," contact project leader Bob Hensler or fire program leader Dick Mangan at (406) 329-3900 or (FTS) 585-3900. ■

Dick Mangan, *program leader, USDA Forest Service, Missoula Technology and Development Center, Fire, Aviation, and Safety Program, Missoula, MT*

The Wildland-Urban Interface: Social and Political Implications in the 1990's[1]

Dan W. Bailey

Zone fire manager, USDA Forest Service, Lolo National Forest, Missoula, MT

Introduction

The morning weather report predicts another hot, dry day. For several weeks there has been no precipitation, and cumulative rainfall is far short of average. A strong, easterly wind moves across dried grass and shrubs in area developments, and surrounding wildland vegetation is brittle-dry from prolonged drought. At noon, a call comes into the local dispatch center: Smoke has been sighted in the forest east of a large subdivision.

By the time the first engines, crews, and air support arrive on the scene, the fire is already out of control. Flames reach 150 feet (46 m) into the air, and burning embers carried by the strong winds are starting new fires one-half mile (0.8 km) in advance of the fire front. The magnitude of the fire quickly outstrips local fire resources, and additional equipment and people are called in. But the fire is moving quickly and some difficult decisions must be made. With insufficient resources, the Incident Commander recognizes that firefighters will not be able to protect all the homes threatened by the fire. There is limited access to the area, and the homes are flammable, scattered throughout the forest, and built too close to trees. These facts plus the sheer size of the approaching fire prohibit fire agencies from saving this community.

In the subdivision, the fire is only minutes away and panic has set in. Local law enforcement personnel are using loudspeakers and going door-to-door to tell residents to evacuate the area. A few desperate homeowners decide to stay to try to protect their homes. Most residents, however, quickly pack what they can into their cars and, as they leave, take a final, backward look at their homes. As smoke from the approaching fire darkens the sky, drivers use their car headlights to see the already clogged two-lane access road. For the next 36 hours, the fire quadruples in size. Finally, it begins to rain.

When the 2-day rainstorm halts the fire, newspaper headlines announce the heavy toll: "Five Residents Dead in Rush of Evacuation"; "Fire Destroys 100 homes, Entire Shopping Center"; "Woodland School Disaster"; "Senior Citizens' Apartments in Ruins." Estimated losses run as high as $50 million. Suppression costs alone are $7 million.

The interface problem is not just another problem for the "fire people" to handle.

For the fire protection agencies, the problems are just starting. The public outcry began within hours after the fire began: Why did it take so long for crews and equipment to arrive? Why was there confusion, duplication, and misinformation? How could a fire like this occur? Local, State, and Federal political leaders have called for investigations, and the media has focused national attention on the disaster. Agency managers and department chiefs have struggled to avoid blaming each other, but some firefighters voiced complaints to the press about the problems of working with other agencies.

Why Is the Wildland-Urban Interface a Problem?

While this story is fictional, it is not unusual to read about such tragedies in the morning paper. Nevertheless, people in most areas of the United States take comfort in the mistaken belief that "it can't happen here." Unfortunately, wildfires can and do happen in every State (Davis and Marker 1987; Gale and Cortner 1987; Laughlin and Page 1987; Bailey 1988, 1989, 1990b). National Fire Protection Association statistics show that in 1985 wildland fires claimed an area roughly the size of Maine, Vermont, and New Hampshire combined. The cost to fight those fires totalled $400 million, while loss to property and natural resources reached approximately $500 million.

Losses of this magnitude can occur any year. In 1987, over 50,000 fires in the United States burned over 2 million acres (809,400 ha). In 1988, fires burned over 4.2 million acres (1.7 ha) and cost the Federal government close to $1 billion in suppression costs. In 1989, millions of acres burned and hundreds of millions were spent in suppression costs. Since 1985, the total suppression costs and property losses have been estimated to exceed $25 billion (NFPA 1991).

No one appreciates these statistics more than those who have the professional responsibility to avert such tragedies. Firefighters from Federal, State, and local fire agencies are on

[1]This article was part of a presentation "Fire in Resource Management" at the National Advanced Resource Technology Training Center in Marana, AZ, in April 1990 and January 1991.

the front lines in these emergencies. They not only see the destruction and human tragedy firsthand but also feel the frustration when their training, experience, and commitment are no match for a major wildland fire (Fischer and Arno 1988).

The root of the problem is the migration from urban to rural areas. In the last 10 years, more and more people have realized the dream of a home in the woods—either as a permanent residence or as a place to get away from the stresses of the city. Rural homes offer a variety of amenities including cleaner air, cleaner water, and a quieter, more self-sufficient lifestyle. Better communication, transportation, and technological improvements have made nonmetropolitan areas more accessible than ever before. Highways cut down travel time, and telephone and computers make it possible to work in locations remote from offices and coworkers. U.S. census figures show that between 1970 and 1988, a population increase of 23 percent occurred in the rural counties around the Nation's wildlands compared with an 11 percent population growth nationwide. This area of growth has occurred amid wildland vegetation such as pine, hardwoods, tall grasses, and chaparral. This vegetation has two elements in common: abundance and flammability.

The point at which flammable vegetation meets structures is the wildland-urban interface. It is this interface that has created the current fire protection challenge. As these interface areas grow in size and number, the probability of more fires and greater losses increases. This, in turn, increases the challenges for the Nation's firefighters, land managers, and resource specialists.

It's Not a New Problem

Fires have always been a factor in wildland areas—we all recognize the role of fire in just about every ecosystem. However, the presence of people in the wildland has complicated the ecological equation in many parts of the United States and Canada.

Fire in the wildland-urban interface are not a new phenomenon. We know, for example, that over 120 years ago there was a major wildland-urban fire in Peshtigo, WI. Settled by immigrants from Eastern United States and Europe, Peshtigo was a thriving lumber town by 1871. That year, a less than normal snowfall, minimal spring rains, and a dry summer produced a serious drought. In October, fires burned throughout the region. The Peshtigo Fire started in the forest and roared out of control, overpowering all attempts to stop it. The entire town was wiped out—not a building remained. More than 1.2 million acres (485,640 ha)—an area about the size of the State of Delaware—burned, and worst of all, 1,500 people died (Peshtigo, the Fire 1954; Bailey 1990a).

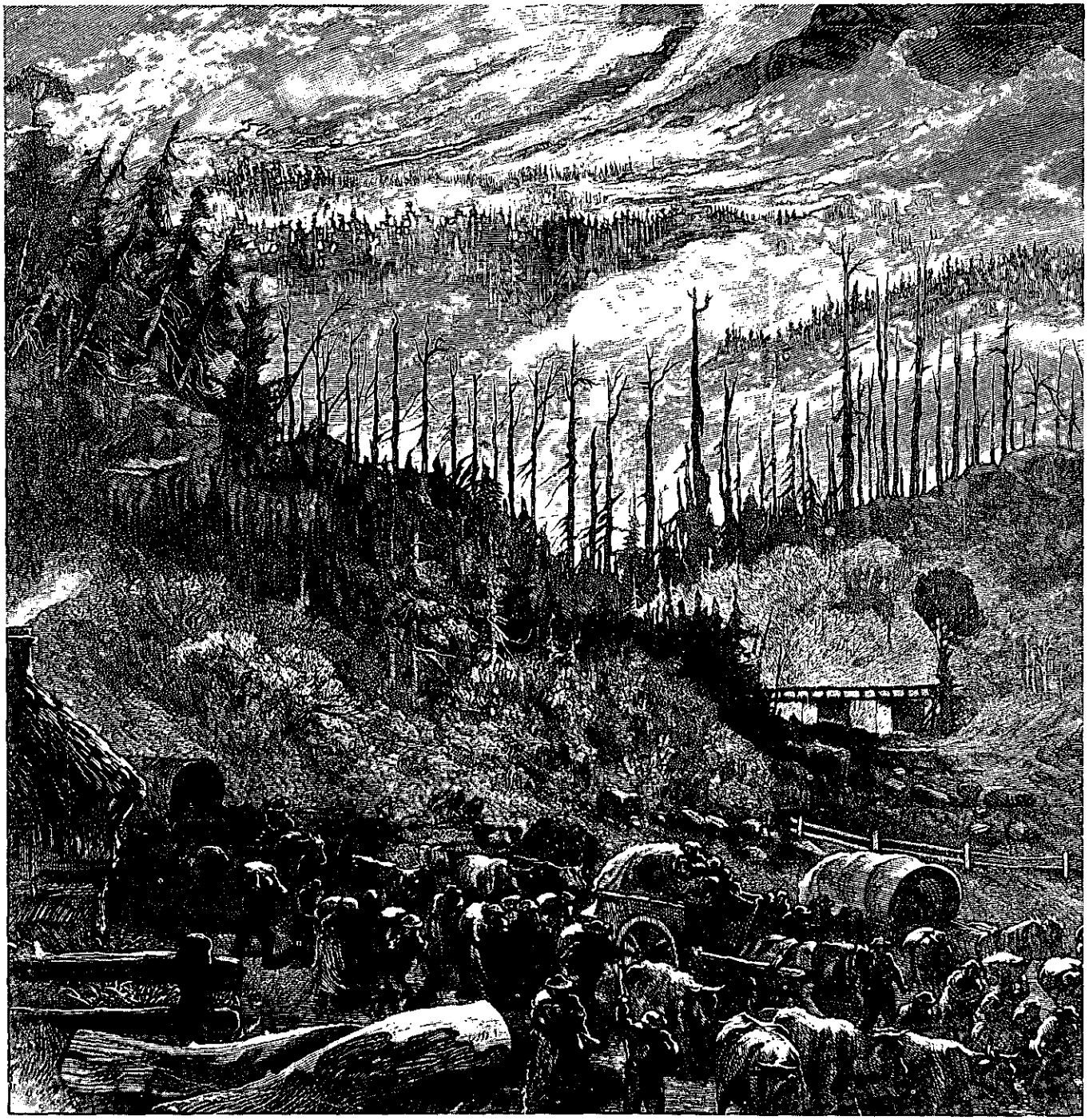
The Peshtigo Fire was the most devastating interface fire in America's history. Yet the recent number of interface fires and the mounting toll in lives and property signal a growing problem.

While the interface problem is national in scope, solutions must be designed and implemented at the local level. People living in or adjacent to wildlands are the number one cause of interface fires. But the characteristics of the interface fire problem are also governed by the combination of vegetation, topography, and weather that define a region or locality and its particular fire conditions. These factors will also define solutions that have the best chance of reducing the potential for disastrous interface fires.

Defensible Space

Wildland fire agencies traditionally respond quickly, efficiently, and with great determination after a fire has started. However, suppression efforts in the interface are often complicated by poor roads, inadequate water supplies, flammable vegetation close to homes, and construction materials such as wood-shingle roofs. Firefighters are often doomed to failure in the face of such conditions.

There is one general protection strategy that has proved its effectiveness in every locality—"defensible space." Creating defensible space involves providing an area between a structure and the surrounding flammable vegetation that is sufficient to allow fire agencies to battle an oncoming wildfire before it reaches structures or to stop a structural fire before it ignites the wildland vegetation. With defensible space, the structure has a chance to survive on its own when fire personnel and equipment are not available—as often happens during a wildfire. Defensible space can be as simple as a minimum 30-foot (9.14-m) clearing between homes and flammable vegetation or as complex as a greenbelt (or series



Early line drawing of famous 1871 Peshtigo, WI, fire. Harper's Weekly

of fuel breaks) surrounding a planned community.

Defensible space is only one of a number of protection strategies, but it is one of the best because it accomplishes three critical objectives:

- To prevent serious fires from ever starting.
- To provide firefighters with a "fighting chance" to stop a wildfire quickly and efficiently and to reduce the tragic cost in property, natural resources, and lives.
- To offer the possibility of a structure surviving a fire on its own when fire personnel and equipment are strained and no immediate help is available.

Planning Strategies

Wildland fire protection agencies have responsibilities in assessing the wildland-urban interface fire protection problem. Agencies can obtain a thorough analysis to help determine where their interface problems are and which ones have the highest priority by following these steps:

- Identify the interface area (use a topographic map).
- Assign an average fuel hazard rating for the area: 1 = small light fuels, 2 = medium fuels, 3 = heavy fuels.
- Assign an average slope hazard rating for the area: 1 = flat to mild slope (10–15 percent), 2 = mild to medium slope (16–40 percent), 3 = medium to moderate slope (41–60 percent), 4 = moderate to extreme slope (61 percent).
- Determine a factored hazard rating by multiplying the fuel rating by the slope rating (slope has a great influence on the rate of spread of a fire).
- Determine an average structure hazard rating by assigning a rating for each structure in the area and dividing by the number of structures: 1 = both roof and siding materials are nonwood or wood shake or shingle; 7 = roof materials are flammable (wood, shake, or shingle), and siding is nonwood or wood shake or shingle; 10 = both roof and siding materials are flammable.
- Determine the total hazard rating: factored hazard rating plus structure rating equals total hazard rating.
- Using the total hazard rating, establish interface priorities—list from the highest to lowest.
- For your own records and to maintain your program priorities, document the interface problem with a short description.

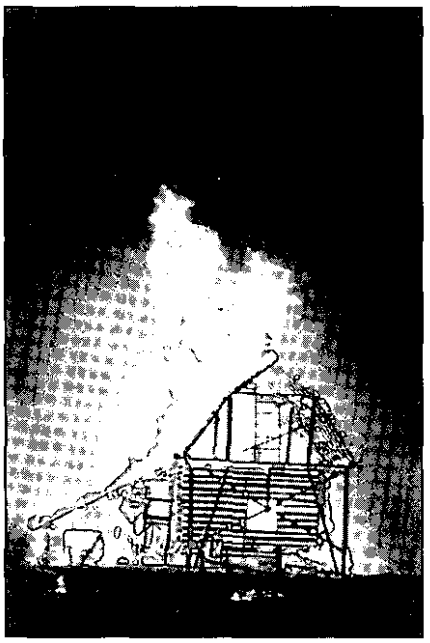
Approaches to Solving the Wildland-Urban Interface Problem

There are a number of approaches that State and local governments have used to help solve the wildland-urban interface problem. A major one is to enact laws that, for example, set codes and standards for building in the interface, that determine defensible space, and that require sufficient access roads. In locations where there aren't codes and standards, however, the only viable alternative is public education, strong cooperation, and thorough planning among agencies. Remember that we are all involved in interagency work. Because fires do not respect political boundaries, sooner or later we will need to work with our counterparts in other agencies. We can either plan ahead to cooperate or try to improvise joint actions when emergencies force the issue.

Get to know your counterpart in other agencies. Meet with local government officials, homeowners, and business groups to listen and discuss fire and resource protection issues. Work in areas where the greatest consensus about problems and solutions exists. Involve the people you protect and listen to their concerns and comments.

Once you have had some success, you will begin to get the attention of people who are happy with the status quo. Listen to these people. There may be unresolved problems between agencies that have created a pessimistic climate for interagency proposals. Work with the people who see a need to improve fire protection in their community or area and let events transpire to bring down barriers and draw other people into the process. Inevitably there will be some conflicts and political infighting, but as time goes on and programs begin to work, conflicts should diminish.

In your own organization, try to get people both at one level above and one level below you involved in this interagency process. Encourage the people you are working with in other agencies to do the same—this can be an excellent method to spread the word informally. Constantly remind people that they do not have to solve all the problems that exist between departments or agencies to create a successful interagency program.



Summer log home near Obando, MT, burns on the Canyon Creek Fire in 1988.

Interface Fires—Stories From the Last 30 Years

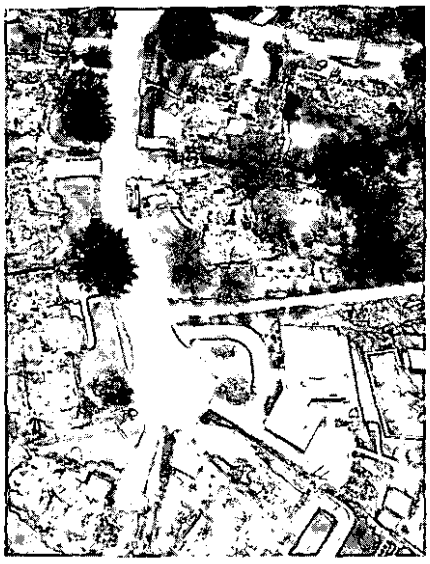
This bird's eye view of wildland-urban interface fires scans events that occurred in the United States from coast to coast and covered nearly 30 years of modern *fire suppression to the present day.*

- On a weekend in 1963, a series of wildfires in the Pine Barrens of New Jersey destroyed 183,000 acres (74,060 ha) of woodland, consumed 186 homes and 197 outbuildings, and claimed 7 lives.
- The Santa Barbara Fire of 1977 started when a kite came in contact with a power line and ignited a brush fire. The fire burned 800 acres (324 ha) and destroyed over 200 homes and other structures.
- In 1985, the combination of drought and wind showed that no place is immune to wildland-urban fires. Florida, which usually receives 50 to 60 inches (127 to 152 cm) of rain, was dry that year. When lightning struck dry woods and grasslands, the resulting fire claimed several lives, 100,000 acres (40,470 ha), and 600 homes and other buildings.
- In 1988, the Greater Yellowstone Area fires burned over 1 million acres (404,700 ha). Firefighters defending world-famous sites, historic parks, and park gateway towns had no relief until the snows began to fall in early autumn.
- In 1990, the Paint Fire in Southern California burned 648 structures, caused $240 million in damages, and cost over $10 million to suppress. Late season fires in Montana and Colorado again showed no State is immune from wildland-urban interface fires.

Buildings in Old Faithful Complex sprayed with water and foam while smoke from the 1988 Greater Yellowstone Area fires billow in the background.

©James Woodcock

Fires rages behind buildings adjacent to the main lodge in the Old Faithful Complex during the Greater Yellowstone Area fires of 1988.

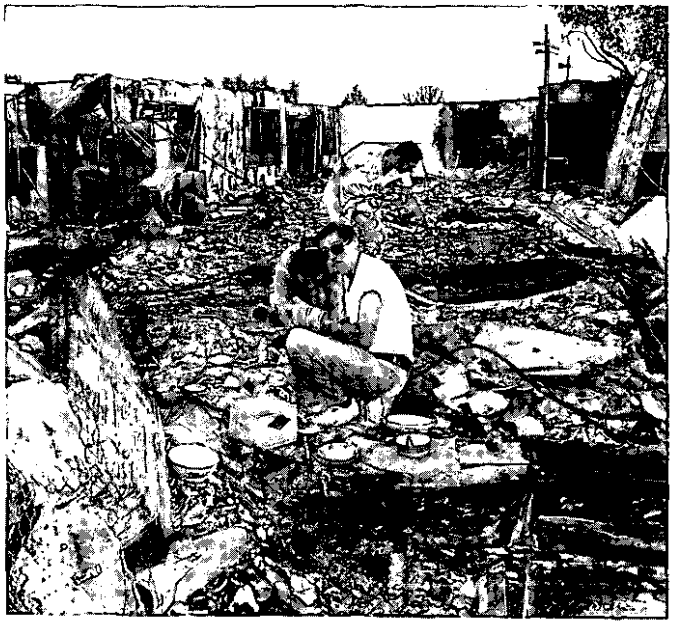


Keith D. Cullom

In Goleta, CA, outside Santa Barbara, 24 out of 26 homes on the street, Camino Molinero, leading to the cul-de-sac, burned on the Paint Fire of 1990.

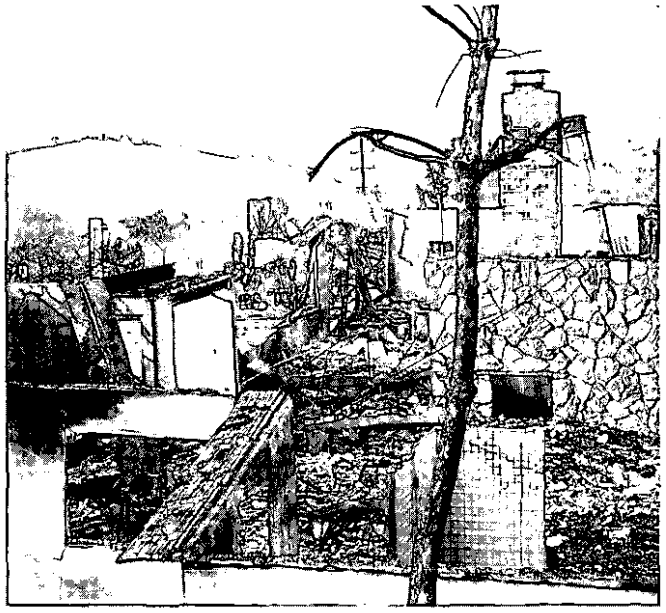
Keith D. Cullom

Debris from Goleta, CA, homes, still smoking from the Paint Fire of 1990.



Keith D. Cullom

Goleta, CA, homeowners sort through debris for personal items.



Keith D. Cullom

The charred remains of Goleta, CA, homes that burned in the Paint Fire of 1990.

Remember that you do not have to give up your organizational priorities or procedures to be able to cooperate with other agencies. Following are six steps to building effective interagency cooperation when dealing with the interface:

- Involve others and obtain a commitment to work together.
- Examine problems that affect all agencies.
- Set realistic goals and objectives that you can live with and accomplish.
- Develop programs and policies that are simple, yet effective—be careful not to be bureaucratic.
- Approve and implement your programs or projects in a timely manner.
- Evaluate and revise the programs and projects as needed.

The interface problem is not just another problem for the "fire people" to handle. Managers and source specialists, local community leaders, and the public have a responsibility and a role.

The Management, Staff, and Public Roles

The Management, staff, and public responsibilities in dealing with the wildland-urban interface are as follows:

- *The land manager*—Recognize that the problem exists, provide direction to staff to develop strategies, work with local government leaders and the public enlisting support, and ensure programs involving more than one agency are well-coordinated.
- *The resource specialist*—Ensure that agency projects and programs near interface or populated areas consider interface and fire protection strategies.
- *The fire manager*—Act as the team leader of the interface programs and work with managers to ensure strategies and programs are well coordinated with specialists, cooperators, community leaders, and the public.
- *The community leader*—Keep informed early in any process; ensure that key leaders are active participants; get the public involved; present programs to such groups as homeowners, service clubs, and schools; contact citizen advisory groups for their suggestions; and use surveys to obtain the community's opinions.
- *The cooperator*—Help coordinate interface projects that involve more than one agency; work together and share responsibility.
- *The public*—Get actively involved in programs such as local fire prevention and interface programs and workshops that deal with vegetative management; make your opinions known.

The 1990's Challenge

In summary, there is much to do. We can build fire resistant structures, we can landscape to reduce fire hazards, and we can modify wildland fuels to reduce fire intensity. We can also build new partnerships with other agencies and departments and with groups and individuals throughout our communities. By working together, not only can we prevent fires, but when they do occur, we can dramatically reduce losses. At times it may be difficult to work together, but the alternative is answering to an angry public that is asking why we did not cooperate during a fire that ultimately turned into a disaster. If we don't break down artificial barriers between agencies, we are gambling with the lives and property of those we have pledged to protect.

Before a fire occurs, those who call for increased protection measures are pessimists and doomsayers. After the fire, these individuals are called "realists." Waiting until the wildfire is raging and we are faced with having to decide which houses to save is far too late. The time to take action is now. ■

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Standard Fire Orders

F— Fight fire aggressively but provide for safety first.
I— Initiate all action based on current and expected fire behavior.
R— Recognize current weather conditions and obtain forecasts.
E— Ensure instructions are given and understood.
O— Obtain current information on fire status.
R— Remain in communication with crew members, your supervisor, and adjoining forces.
D— Determine safety zones and escape routes.
E— Establish lookouts in potentially hazardous situations.
R— Retain control at all times.
S— Stay alert, keep calm, think clearly, act decisively.

Property: Where Is It and How Did It Get There?

Keeping track of property—property accountability—is a constant concern for *property managers. Property tracking is not an easy job, not in private* (remember that camping trip?—trying to come home with all the gear (and the kids) you started out with?) and especially not in interagency emergency fire situations. To improve performance, Fire and Aviation Director L.A. (Mic) Amicarella has created a Property Accountability Awareness Group charged with telling the accountability story to the fire community. Below is Director Amicarella's letter to the Regional Foresters and Area Director about the new group and their work. Look for more information on property accountability in *Fire Management Notes.*

United States Department of Agriculture — Forest Service — Washington Office — 14th & Independence SW, P.O. Box 96090, Washington, DC 20090-6090

Reply to: 5100 Date: August 26, 1991

Subject: Property Accountability Awareness

To: Regional Foresters and Area Director

Property accountability on incidents has long been a concern for cache managers *and other individuals responsible for real or personal property. Procedures* for tracking accountable property are well documented in the National Mobilization Guide and are included in various incident management training packages. Nevertheless, each year problems with tracking accountable property still occur. When questioned, most often people respond that they "didn't realize a particular item was accountable property" or they "forgot to transfer the item to their replacement when they turned it over to them." This is in addition to problems caused by inexperience.

As an effort to reinforce property management guidelines and previous training efforts, I have designated a Property Accountability Awareness Group whose function will be to supply periodic reminders to all levels of the fire community on the importance of maintaining good property accountability. Bev Bakke has volunteered to chair the group. I have charged this group with periodically providing articles for inclusion in "Fire Management Notes" and other fire suppression publications which emphasize property accountability concerns and offer techniques to resolve them for a variety of incident and management perspectives.

The individuals listed below recognize the concern over property accountability and have agreed to serve on the Awareness Group.

Beverly Bakke	BIFC, Administrative Officer
Ken Briggeman	R-1 (Kootenai NF), Logistics Section Chief
Don Ratcliff	R-8, Regional Property Management Officer
Dale Stanley	R-5 (Shasta-Trinity NF), Supply Unit Leader
Robert Benkosky	R-5 (Shasta-Trinity NF), Incident Commander
Sherry Hermanns	R-5 (RO), Support Services Specialist in Property Management Group
Bill Burge	BIFC, Tools and Parts Attendant, Telecommunications
Scott Baily	WO, Personal Property

Your assistance and encouragement in this group's efforts will go a long way in getting on top of the property accountability problem on incidents.

/s/L. A. Amicarella
L. A. AMICARELLA, Director
Fire and Aviation Management

The Forest Service and Fire Control

Terry West

Historian, USDA Forest Service, Public Affairs Office, Washington, DC

At one stroke the Transfer Act [1905] made an obscure government agency into a landholder with an estate larger than that of many nations. Likewise, the new responsibility compelled a somewhat arcane and foreign subject, forestry, to expand its interests and vision, placing it center stage for a while in the great national drama of the conservation movement. And it subjected both forestry and the Forest Service to a literal trial by fire.

—Stephen J. Pyne, Fire in America, 1988: 182

Fire control began as a crusade for the first generation of Forest Service employees, part of the effort to promote conservation forestry in the Nation.

Fire Protection—a Fundamental Mission

When forestry—the science of planting and taking care of forests—began on the forest reserves in America, its practitioners regarded fire protection to be a fundamental mission of the profession. Gifford Pinchot, as Chief of the Division of Forestry, wrote in his 1899 "Primer on Forestry" that fire was the main enemy of the North American forest. In 1901, the Secretary of the Interior, Ethan A. Hitchcock, operated on the same assumption when he wrote "the first duty of forest officers is to protect the forest against fires" in his outline of duties and responsibilities for forest officers. By horseback or foot, the early ranger was expected to rush to a fire and control it, if fortunate, with a team raised from local residents, or alone, if necessary.

With the 1905 transfer of the forest reserve lands to the Department of Agriculture under Forest Service administration, fire protection on the national forests became national in scope. A fire control mission was used to justify the agency's creation, and its success or failure in fire control became the public test for whether the agency was needed (Pyne 1981).

The Status Quo and a Shift in Attitude

Uncontrolled wildfires—such as the 1871 fire that wiped out the lumber town of Peshtigo, WI, burned over 1 million acres (404,700 ha), and killed over 1,400 people—generated public support for the new movement calling for forest conservation. The shift in attitude was gradual since the concepts of both forestry and fire control were strange to most of the population in the late 19th century. Bernhard Fernow, a forester trained in his native Germany, characterized the careless attitude toward fire found in rural America, where campfires were left unattended, forests burnt to create grazing lands, and sometimes forest visitors lit ancient trees just to watch them burn, as "one of bad habits and loose morals" (Pyne 1981).

Economic and technical reasons lie behind the frequent uncontrolled wildfires of the period. The massive slash fires that followed clearcutting in the Lake States were left to burn because industrial logging was not yet committed to reforestation and sustained yield. The cost of fire control on lands owners did not plan to hold canceled the economic return on a fire suppression investment. Furthermore, in an economy heavily dependent on agricultural output, once burned clear, the land could be tilled for farming. Aside from being economically unjustifiable, fire control was not considered technically possible.

Fire Control—First Steps

The incentive for fire control did not emerge until State and private forest reserves existed following the "end" of the timber frontier by the late 1800's. By then, it became apparent, especially in the East, that the Nation's vast forests did, indeed, have limits. Among the first to establish fire patrols ("fire ranging") were the State of New York for its Adirondacks reserve (1885), the Province of Ontario, Canada (just across the border from New York), and the U.S. Army in Yellowstone Park (1886). As mentioned earlier, the Department of the Interior at the turn of the century tried to control fire on the forest reserves by directing its forest officers to fight them.

Conservation and Its Link to Fire Control

A surge in concern about forest conservation, starting in the 1870's, brought the advent of Federal forest reserves in 1891 (renamed national forests in 1907). In the East, this concern turned into a movement supporting the purchase of lands to create additional forest reserves. To justify (in part) the shift of ownership of forest lands to the Federal Govern-

ment, proponents cited the need for fire control and lamented the lack of such efforts on the part of the private sector and even the States. The Weeks Act of 1911 linked additional reserve creation with fire control measures. The Act authorized adding forest land to the national forests by purchase or exchange and for cooperative fire protection between the Federal and State governments.

Before the big Western fires of 1910, the States had made little progress in protecting privately owned forest lands from fire. In 1911, 25 States had forestry organizations, but they mostly limited their work to information gathering and advising woodlot owners. Only 16 States had a fire protection association. A few private fire protection associations existed, for the most part pools of major timberland owners in the Pacific Northwest. Most of these private associations are now replaced by State fire protection associations.

Fire Control Costs and Scientific Research

Fire control was expensive. To meet this problem, the 1908 Forest Fire Emergency Act allowed deficit spending in years of bad fires. The Forest Service first tested the muscle of the Act in 1910, spending $1 million fighting the disastrous fires in Idaho and Montana (burned 3 million acres or 1.2 million hectares and killed over 80 firefighters) and then "faced bankruptcy" (Pyne 1981). The 1910 fires challenged the leadership of the new Chief, Henry Graves, along with that of Northern Rockies district forester (early title for regional forester), William Greeley, and assistant forester, Ferdinand Silcox (both later served as Chief). Chief Graves acted by beginning a program of scientific research on fire.

California district forester, Coert DuBois, took the research lead. In 1914, he published "Systematic Fire Protection in California," the well-known study analyzing the behavior of fire and how it could be controlled. He noted that U.S. foresters faced a "unique fire problem" not found in Europe, and therefore had to develop their own solutions for fire protection and planning (Pyne 1981). His analysis and other California research seriously challenged the benefits commonly attributed to "light burning" (a practice commonly used by homesteaders to clear underbrush through controlled fires).

Among the other Forest Service's notable innovations during the formative years of fire protection were the first aerial forest fire patrol in 1919, Dwight Beatty's pioneer development of the portable two-way radio to be used in the field for fire control in the late 1920's, and smokejumping (tested in 1939 and put into practice in 1940). Earlier in 1921, the year Greeley became Chief, the agency dedicated the Priest River Experiment Station in Montana to fire research.

Chief Greeley did not focus on fire ecology research, stressing instead applied control work. After all when Congress passed the Clarke-McNary Act in 1924, expanding the cooperative fire protection provisions of the 1911 Weeks Act, it made cooperative fire protection the foundation of a national program of forest management. Congress appropriated money for Forest Service cooperative programs with State forestry agencies for work on fire control as well as other cooperative forestry projects.

Fire control began as a crusade for the first generation of Forest Service employees, part of the effort to promote conservation forestry in the Nation. In time, firefighting became integral to the public image of the agency, with the icon of Smokey Bear appearing first on a fire prevention poster in 1944. Internally, fire suppression became a badge of identity within the agency. The shared experience conferred acceptance into the ranks. Now, the creation of specialized fire crews and contract crews limits direct participation for many employees, but during fire season when the weather is dry and east winds blow, we all sniff the air for smoke. ■

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Sharing the Editing Joy

Donna Paananen, editor at the North Central Forest Experiment Station in East Lansing, MI, coedited this issue of *Fire Management Notes*. Thanks, Donna, for using your editing skills, your experience in fire research editing, and your creative bent in the publishing of this issue. *Fire Management Notes* needed your help and profited immensely from your input and exchange of ideas.

Fire and Archaeology[1]

Larry Swan and Charla Francis

USDA Forest Service, Region 5, district archaeologist, Sierra National Forest, Pineridge Ranger District, Shaver Lake, CA, and forest archaeologist, Stanislaus National Forest, Sonora, CA

There are thousands of prehistoric and historic sites in California resulting from over 10,000 years of human occupation. (Sites such as these can be found in every State in the Nation.) During this time, wildfires have occurred on a regular basis, and their effect on archaeological sites has been minimal. Over the last 80 years, however, with the advent of active fire suppression, the effects of fires and fire suppression on archaeological sites have greatly increased.

Increased Impact—Why?

One effect of fire suppression has been increased fuel buildup; there may be fewer fires, but those that occur tend to burn more intensely. These types of fires can destroy or greatly alter chipped or groundstone artifacts, as well as make difficult the protection of historic remains such as cabins and other structures. Another fire suppression effect has been the disturbance resulting from fire suppression activities. Thousands of years of human remains can be obliterated through the use of mechanized equipment. The most commonly perceived use of mechanized equipment during fire suppression is the use of tractors to construct firelines. However, severe disturbance can also occur during the construction of helipads, water site developments, fire camps, and staging areas.

Archaeological sites are nonrenewable resources.

Postfire Effects

An often overlooked, potentially disturbing effect of fires is the activity associated with watershed rehabilitation efforts. Depending upon design and location, a rehabilitation project can be either beneficial or detrimental to archaeological sites. For example, watershed rehabilitation projects that may be beneficial are streambank stabilization, off-highway vehicle barriers, and water control measures. Detrimental effects are usually related to excavations or mechanized-equipment use within site boundaries and downstream effects of watershed projects undertaken without considering archaeological sites.

In timber country, probably the most widespread and potentially the most disturbing fire effect results from salvage logging. Destruction of archaeological sites will occur unless an archaeological survey is conducted and sites are protected before logging. Even if an area has already been surveyed, postfire surveys will reveal sites previously hidden by duff and slash, and better ground visibility will allow refinement of boundaries of known sites.

Most resource specialists are accustomed to dealing with multiple resource concerns and mitigating the effects of one use on the other. During and after fires, however, for reasons such as fatigue, stress, and sense of emergency, resource specialists may inadvertently not consider certain resources when designing and locating a project. In the case of archaeological sites, such a mistake will result in irreparable damage.

Input From the Archaeologist

Archaeological sites are nonrenewable resources. Personnel working on fires, both during and after an incident, are strongly encouraged to consult with local archaeologists about project location and design and include archaeologists as an integral part of fire suppression and rehabilitation efforts. Not only is this good resource management, but when Federal land is involved, agencies are legally required to follow Code of Federal Regulation procedures (36 CFR 800) for postfire projects involving archaeological sites. ■

[1]From the Proceedings of the Symposium of Fire and Watershed Management, October 26-28, 1988: Sacramento, CA. Gen. Tech. Rep. PSW-109. Berkeley, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Forest and Range Experiment Station. p. 156.

Human Resource Specialists in Action

Melanie Goss, Gary Kellogg, and Norm Carpenter

USDA Forest Service, Region 1, personnel officer, Lewis and Clark National Forest, Great Falls, MT, and land management planning specialist, Nez Perce National Forest, Grangeville, ID; and Region 5, landscape architect, Sequoia National Forest, Porterville, CA

The Human Resource Specialist—the Need, the Review, the Future

The human resource specialist has helped Incident Commanders on fire incidents monitor actions affecting civil rights and coordinate measures to ensure a safe working environment for firefighters and support personnel since 1988. Before 1988, incidents of reported inappropriate behavior such as sexual harassment and racial discrimination in fire situations were sometimes not dealt with in a timely and responsive manner.

Aware of the need for change, the USDA Forest Service Deputy Chiefs for Administration and State and Private Forestry formed a taskforce in 1987 to investigate what could be done. The taskforce concluded the human resource specialist position was necessary to ensure that a positive working environment, supportive of cultural diversity, would be maintained and enhanced for all incident personnel.

On the basis of the taskforce recommendation, the human resource specialist position has been incorporated in the Incident Command System and used in each region to varying degrees. In 1990, a group made up of representatives from each region examined the status and effectiveness of the position. The group made these key observations in its report:

- All regions are in unanimous agreement that the human resource specialist position has provided numerous benefits to the Forest Service and should be continued.
- Currently, there are 150 people trained as human resource specialists: 128 in the Forest Service, 12 in the Bureau of Land Management, 6 in the Bureau of Indian Affairs, 2 in the National Park Service, and 2 in the Montana Department of State Lands.
- The distribution of the 10-minute video titled, "It's a Burning Issue," which introduces and explains the function of the human resource specialist position, would be helpful to the fire community in each region. The distribution to each region is now complete.
- During the 1989–90 fire seasons, approximately 125 human resource specialists were dispatched to fire incidents.

Some of the recommendations of the report have been approved by both Deputy Chiefs and are currently being implemented.

Contribution to the Incident Command in a Culturally Sensitive Place—Pilot Knob-Pilot Rock Nez Perce Indian Tribe Religious Rites Area

On July 26, 1989, a lightning storm started numerous fires in the Nez Perce Tribe's Pilot Knob and Pilot Rock Religious Rites Area in the Clearwater Mountains on the Nez Perce National Forest in Idaho. For the Incident Commander, fighting the Silver Dome Fire meant developing a strategy and tactics sensitive to the religious significance of this area to the Nez Perce Tribe.

The human resource specialist assigned to the incident played an important role in dealing with the special concerns of the Nez Perce Tribe. Through the specialist's efforts, Silas Whitman, member of the Nez Perce Tribe, wrote the firefighters a short history of the Nez Perce experience in this area and an interpretation of its meaningfulness to the Nez Perce. The firefighters learned that Pilot Knob Mountain and the surrounding area have been, and continue to be, important to Nez Perce Indian cultural practices such as religious ceremonies, vision questing, power seeking, and dream gathering. "The site of Pilot Knob," Silas Whitman wrote, "is at the center of the four corner universe and has adjacent holy points in each of the four directions." Here also Nez Perce Tribal members gather medicines, roots, and berries of special significance in their use and impact.

The Incident Commander decided—after consultation with the Nez Perce Tribe through the human resource specialist—to allow only Nez Perce tribal firefighters to suppress the fire in the most culturally sensitive portion of this religious rites area. The success of this and other decisions is reflected in a letter the Tribal Chairman Allen V. Pinkham wrote to the Incident Commander. He writes:

> I am grateful for your work and extend my thanks and appreciation to all who were on the lines and those in support as well .... Thanks again for we are all brothers and sisters when we protect and enhance all our creator's natural resources.

Ready in a Crisis

The human resource specialist has a unique position within the Incident Command System. Working in con-

Working in concert with the Incident Commander, the human resource specialist looks after the welfare of firefighters assigned to an incident and works with individuals having difficulty in this environment.

cert with the Incident Commander, the human resource specialist looks after the welfare of firefighters assigned to an incident and works with individuals having difficulty in this environment. Just how important the specialist is to the firefighters and to the Incident Commander was demonstrated last summer in California.

On August 9, 1990, two lightning fires joined to form the Stormy Complex Fire on the Sequoia National Forest. A total of 2,500 people worked in firefighting and support positions to contain this 24,000-acre (9,713 ha) conflagration. Gusting, swirling winds pushed the fire through steep canyons and across rolling timberlands, creating a gigantic firestorm in the dry forest. A spike camp, located in a meadow once miles from the fire, was quickly engulfed by flames that stretched 200 feet (60 m) into the air. Several hundred people in the meadow made a hasty, controlled retreat but 56 remained while fire swept around the meadow. For those people, although physically unscathed, this was a moment of extreme emotional stress.

This event immediately focused the human resource specialist's concern on stress management. Unseasoned support personnel, as well as experienced firefighters, were emotionally strained. Professional counseling services were unavailable on short notice, except by telephone; thus, the human resource specialist became a counselor to the person experiencing stress or a coordinator between the professional and the individual.

Watchful supervisors, aware of uncharacteristic behavior from their personnel, and individuals, mindful of changed emotions, asked for help. The human resource specialist listened with empathy and understanding to each person in need of help and then discussed with that person, his or her desire to talk with professional counselors. Using this approach, the specialist met with dozens of people over a 3- to 4-day period. Many people discussed their feelings immediately by telephone with a counselor or met with a counselor in a day or two. Others felt content with talking to the human resource specialist.

The human resource specialist occupies an important position in the Incident Command System. Besides other anticipated duties, the specialist can intervene in times of crisis, helping firefighters reduce emotional stress. Through a specialist's efforts, the Incident Commander has a better opportunity to resolve problems and concerns while at the incident base before employees assigned to the fire return to their homestations. ■

Column of smoke rising from the Pilot Knob-Pilot Rock Nez Perce Indian Tribe Religious Rites Area, Silver Dome Fire of 1989.

Security Surveys for Wildland Fire Protection Facilities

George M. Brown

Emergency services coordinator, San Luis Obispo County Office of Emergency Services, San Luis Obispo, CA

The Problem

The impact of creeping urbanization into wildland areas (the wildland-urban interface) has not only presented new challenges to fire protection but has also made firefighters aware of how vulnerable they are to crime. Where once fire protection personnel in remote or rural facilities thought they were safely away from crimes usually associated with cities, increasingly they have discovered that they have been victims of petty theft or vandalism. Crimes often occur when personnel have vacated wildland fire facilities during an emergency. Criminals have stolen both personal and government property ranging from food and VCR's to tools and computers.

Help from Crime Prevention Unit

These problems caused concern in the San Luis Obispo County Ranger Unit, part of the California Department of Forestry and Fire Protection (CDF). Ranger unit personnel, who have the primary responsibility for preventing and suppressing wildland fires in the unincorporated areas of the county, were aware that a variety of items, including those critical to accomplishing their mission, were being pilfered. They called upon the County Sheriff's Crime Prevention Unit to help them develop a program of security surveys for their facilities and sites.

SAFETY/FIRE SAFETY/SECURITY/EMERGENCY PREPAREDNESS
SURVEY REPORT

DATE _____ Page ____ of ____

Building/Area _____
Room Name/Number _____
Person Responsible _____

Problem Description	Suggested Solution	Relative Risk X Repair Ease = Priority							Target Completion
		1	3	6	1	2	3		

D:\WP51\DOC\GB3\FORMS\SURVEYRPT.FRM

Figure 1—*This survey report is used to determine priority for crime prevention tasks and to assign a target date for completion of them. Note that "relative risk" is multiplied by "repair ease" to determine the highest priority. (See fig. 2 for the key to this report.)*

Typical Crime Prevention Recommendations

Exterior Doors

- Existing locks in old and worn door, hardware, or frame combinations often do not work well and need to be repaired or replaced.
- A four-screw security strike plate should be installed to take advantage of the full potential of a dead-bolt lock.
- There is an inherent lack of security when common key-in-knob locks are used. To secure the station, use a quality, keyed lock on only one door, and install auxiliary dead bolts with no key on the outside and only a thumb turn on the inside of all other doors.

Windows

- Double-hung windows need to be drilled and pinned.
- Sliding windows need dowels in the lower track and sheet metal screws in the upper track; many retrofit, energy-efficient windows have a manufactured depression in the upper track and should be considered for future replacements.
- Windows in "shops" and apparatus rooms should be boarded up; they do not provide enough light to work by and are an easy place for criminals to enter. New facilities should *not* have windows in such areas.

Security Lighting

- Lights should be operated by photocells rather than timeclocks.
- Incandescent floodlights should be replaced with rectangular quartz halogen fixtures. (These are more energy efficient, and they provide better lighting.)
- High-pressure sodium "flat packs" should be considered for doorways and sides of buildings that do not need floodlights but do need security lights.

Personal Property Lockers

- Hasps should be provided so that individuals have the option of a secure space for their personal property—this is more effective than providing installed cabinet locks which require key control.

Exterior Furnace and Water Heater Rooms

- Personnel need to be aware that these rooms can provide a hiding place for criminals or can offer them easy entry to an entire facility.
- Doors, locks, and hardware combinations need to be improved in these rooms.

Key Control

- Key boards, lockers, and cabinets should not be located where the general public can see them easily.
- Keep keys in a locked file cabinet.

Storage

- Firehose and fireline handtools should be stored in locked areas where there are no windows.
- A secure, preferably hidden, place should be found to safeguard petty cash and recreation funds.
- Unoccupied buildings need to be kept locked unless personnel are working in and out of them. This precaution is especially important during the nonfire season.

At that time, I worked for the sheriff's department as a crime prevention specialist responsible for rural and agricultural programs. Thus I was the person assigned to meet with CDF fire prevention officer Richard Caddy to develop a proactive crime prevention program. This program was pilot-tested at a remote wildland fire station before being presented to the ranger unit staff for approval.

The Procedure

Approximately one week before I conducted a survey of the various stations and facilities in the ranger unit, I sent each supervisor a portfolio of crime prevention materials. They could use these materials for personal professional development and inservice training of their crew. When I arrived at each location, I reviewed the portfolio with the supervisor.

My visit to the actual sites lasted about 2 hours and mainly consisted of a security survey. I would do this by walking around both the inside and outside of the facility with the supervisor. This enabled me to discover areas vulnerable to criminal activity and suggest how to make the facility safer. Some typical areas that needed improvement were doors and windows with inadequate locks, exterior lighting, and key control. In several facilities, emergency personnel did not have their own lockers to secure their personal property.

For each survey, I prepared a report, using a standard form (fig. 1). For each point of vulnerability, I assigned a value for both "relative risk" and "repair ease" using a pre-

established scale (fig. 2) as a guide. The supervisors used these reports to help them decide how to allocate resources to make their stations safer and also to plan future budget requests.

Suggestions

One significant suggestion I made was to use an owner-applied number program as part of the nationwide Operation Identification (Operation ID). The ranger unit was assigned a unique number consisting of the two-letter Postal Service State abbreviation (for example CA for California), a three-number county identification (for example, 040 for San Luis Obispo), and a four-number, one-letter individual identification (for example, 0008-C). The number with all its components together, would look like this: CA-040-0008-C. The assigned number is engraved or painted on tools, office equipment, computers, televisions, audio-visual equipment, tires, batteries, generators, and other equipment.

Crimes often occur when personnel have vacated wildland facilities during an emergency.

I also suggested that the ranger unit prepare an inventory containing the description, make, model, and serial number of the items (e.g., typewriter, electric; IBM; Selectric

SURVEY REPORT KEY

The Survey Report is a management tool to facilitate informed decision making. The person making the survey will complete the Problem Description and Suggested Solution columns, and then make an estimate of Relative Risk and Repair Ease based on the criteria indicated below. The product of these two factors indicates a suggested priority for accomplishing the task, with a larger number indicating the first task to work on. Based on available resources, management can assign the Target Completion Date.

RELATIVE RISK

VALUE	CRITERIA
1	Security Low probability of intrusion Low likelihood of theft Loss of property would not significantly interrupt business operations Fire Safety Low likelihood of ignition Minimal fuel load Property loss potential small Minimal life safety risk Emergency Preparedness Damage potential more of an inconvenience nature Little life safety hazard Little business interruption potential
3	Security Items of significant value involved Ease of entry/lack of probability of discovery during entry Unlikely to discover loss/entry until later date/time Fire Safety Potential for significant fire spread Potential for significant structural loss Beyond the capability of on-site resources Emergency Preparedness Significant property damage Significant disruption of normal routine Potential for numerous but moderate injuries
6	Security Small, high-value items involved High probability of/vulnerability to criminal activity Difficult-to-replace items Significant potential of business interruption due to criminal activity Fire Safety Significant life safety hazard Explosion potential Any fire likely to be large and fast moving Emergency Preparedness Problems of structural collapse and entrapment Loss of life and severe injuries Long-term mitigation Communitywide impact

REPAIR EASE

VALUE	CRITERIA
3	Requires little time (typically easy-to-do job) Utilize existing work force, with no significant training Use on-hand materials
2	Requires purchase of tools or low-cost consumable supplies Accomplish with available personnel
1	Requires significant consumable supplies or capital outlay May require advance budget approval May require management approval May require detailed plans Often involves outside contractors

Figure 2—*This survey report key is used to estimate the "relative risk" of security at a wildfire fire facility and the "repair ease" to mitigate security problems.*

II; 123456) as well as the identification number for each item. If anything is stolen in the future, the ranger unit can use the inventory list to notify police of missing property. When items are found, law enforcement agencies throughout the country that use the National Crime Information Center computer system can use the identification number and the inventory information to locate the owner.

Another suggestion is that supervisors should make certain that full-time emergency personnel are aware of crime prevention procedures and strategies. These employees should be reminded that they must set an example for and increase the awareness of part-time and seasonal personnel in keeping the wildland fire facility secure. (See box for other recommendations to improve security.)

In 2 months, I surveyed 24 facilities in a 3,316 square mile area (8,588 km^2). An informal followup review with several station supervisors showed that they had put many of the survey suggestions into practice and the proactive crime prevention program has been successful. ■

Wildland-Urban Fire-Loss Mitigation: An Ongoing Problem for Insurance Companies

In 1990 alone, more than 600 homes were destroyed by wildfires. Many, if not the majority, of these homes were insured by homeowner insurance policies. Payment of home-loss claims costs insurance companies 10's of millions of dollars. Most of those losses could have been prevented if the homeowners had taken the proper mitigating measures to protect their homes from the threat of wildfires.

Public education about the wildland-urban interface has recently been a major fire prevention method, and the National Fire Protection Association (NFPA) has played a significant role in this effort. However, one facet of public education seems to have been overlooked in this effort—the role that insurance companies can and should play in wildland-urban fire-loss mitigation.

When rating residential property insurance for homes located in a wildland-urban interface, insurance companies should, in addition to other rating factors, evaluate the structure in terms of the threat that a wildland fire would present. This evaluation should include:

- Infrastructure of the interface area
  - *Access routes (location, type, number)*
  - *Roadway widths*
  - *Bridges (width and load capacity)*
  - *Road and structural identification*
  - *Water supply (type, dependability, number of hydrants—if present, alternate water sources)*
  - *Location of utilities*
- Fuel hazards in the interface area
- Slope hazards in the interface area
- Structural evaluation of the residence
  - *Chimney*
  - *Combustible exposure control*
  - *Louvers, windows, and openings*
  - *Roofs*
  - *Other building issues (for example, clearly visible house numbers and storage tanks for hydrocarbon fuels)*
  - *Defensible space*

If the residence is a mobile home, there are additional issues to be addressed including trailer skirting, roof type, added decks, and porches.

Insurance companies would assign rating points for these items. Factoring in the rating points from the wildland-urban risk assessment helps determine the cost of the applicable homeowner's insurance. In "extreme cases," the assessment could play a role in determining whether or not the insurance company would insure the structure.

After the assessment, a representative from the insurance company could talk to the homeowner about the findings in terms of what the homeowner could do to mitigate potentially hazardous conditions. These mitigation measures, when carried out, could—in addition to reducing the risk from wildland fire—reduce the overall insurance premium. To keep current on changes in the interface and the residence, the wildland-urban risk assessment would have to be repeated on a regular basis (for instance, every 3 to 5 years).

By taking part in such a program, the insurance companies not only perform a valuable role in wildland-urban interface fire protection but also go a long way towards reducing their monetary losses due to wildland fires. ■

Douglas J. Riley, *fire management officer, USDI National Park Service, Columbia, NJ*

Southern Oscillation Anomalies and Their Relation to Florida Wildfires[1]

Jim Brenner[2]

Fire management administrator, Florida Division of Forestry, Tallahassee, FL

Introduction

As early as the 16th century, explorers recorded instances of violent weather and associated wildfires in Florida. Their written accounts indicate how overwhelming these natural phenomena seemed to them. Núñez Cabeza de Vaca, for example, made these observations near what is now Tallahassee: "... many of the standing trees were riven from top to bottom by bolts of lightning which fall in that country of frequent storms and tempests" (Núñez Cabeza de Vaca 1542). A significant number of these air-to-ground contacts resulted in wildfires, near Fort Caroline as described by de Laudonnier in August 1587:

> ... For although the medows were at that season all greene, and half covered over with water, nevertheless the lightning in one instant consumed above five hundred acres [202 ha] therewith, and burned with the ardent heate therof all the foules which tooke their pastime in the medows, which thing continued for three days space ....

Over the past decade, and particularly since the extreme El Niño event of 1982–1983, it has become popular to attempt to establish correlations between the El Niño/Southern Oscillation (ENSO) phenomena in the central and eastern Pacific and climactic anomalies in other parts of the world. Periods during which sea surface temperatures (SST) in the central and eastern Pacific Ocean are higher than normal and are associated with the Southern Oscillation (SO) are referred to as El Niño; periods when the SST is lower than normal are generally now called La Niña (Philander 1983). Nicholls (1983) attributes the SST warmings in the east equatorial Pacific to rapid horizontal redistribution of heat in the upper ocean in response to anomalous weakening of the trade winds over the west equatorial Pacific. Douglas and Englehart (1981) noted a number of potentially important relationships between Pacific air-sea interactions and rainfall in Florida. Their work indicated a strong and apparently useful "teleconnection" between autumn rainfall in the central equatorial Pacific and subsequent winter precipitation in south and central Florida. Ropelewski and Halpert (1986, 1987) also found the winter (cool season) precipitation over Florida to be positively correlated with ENSO indicators such as the SO index. In addition, Douglas and Englehart (1981) noted that during years of below normal precipitation, there were indications of a weakened and northward displacement of the jet stream, suggesting decreased storm activity in the Gulf of Mexico that favored a milder, drier winter in Florida. Using 53 years of data, Simard et al. (1985) found a significant decrease in wildfire occurrence in the Southeastern United States during ENSO periods. Swetnam and Betancourt (1990) found a correlation between low values of the SO Index and reduced wildfire occurrence in the Southwest United States, but they did not determine which environmental factors were responsible for the relationship.

It may be possible to develop a predictive model for wildfire activity in Florida, based on observed sea surface temperature and sea level pressure anomalies.

The purpose of this study was to explore relationships between Florida acres burned by wildfires and certain ENSO indexes in the Pacific during the winter in the Northern Hemisphere. I've emphasized acres burned rather than fire occurrence because the factors under study affect wildfire intensity or spread which, in turn, controls the final size of a wildfire. Fire intensity is controlled by the short- and long-term environmental factors including relative humidity (RH), windspeed, and rainfall. Fire frequency or occurrence in the Southeast is frequently a reflection of social behavior rather than climate or weather. Thus I determined that acreage would be a better indicator for this study than would fire occurrence.

Data and Computations

Data for acres burned monthly by wildfires between January 1981 and April 1991 were obtained from the Florida Division of Forestry and are included in table 1. Note in table 1 that peak fire occurrence was in February, while the maximum number of

[1] Reprinted, in part, with permission from *The International Journal of Wildland Fire*, 1991, 1(1): 73–78.

[2] **Author's Acknowledgement.** I would like to gratefully acknowledge the support and assistance of Chester "Chet" Ropelewski of the Climate Analysis Center in Washington, DC. Without his support and suggestions this effort would not have been as complete as it is.

acres burned was in May. Florida's typical fire season is from January through May, and the majority of wildfires during this time are human-caused. The largest number of lightning-caused fires occurred in July, which coincided with a peak number of thunderstorms.

The Climate Analysis Center provided the following data for 1950 through 1989:

- East Pacific (west coast of South America) SST anomalies (in °C) (ship track No. 1 of Rasmusson and Carpenter 1982).
- Darwin sea level pressure (SLP) anomalies (standardized).
- Central Pacific (Hawaii to Fiji) SST anomalies (in C°) (ship track No. 6 of Rasmusson and Carpenter 1982).
- Standardized Tahiti minus Darwin SLP indexes. (The data were collated and averaged for January through May.)

Computations were performed to produce simple linear regression, scatter diagrams, and line graphs over time.

Analysis and Results

January through May averages were correlated directly with the corresponding year's data for acres burned. The first phase of the analysis was to compute simple correlation coefficient (r) values for each of the four variables above (see table 2). The best correlation coefficient was derived from the average central Pacific SST anomalies with a value of –0.71 indicating these anomalies correlated with fully 50 percent of the variation in acres burned in Florida.

How This Study Was Done

In this study, Jim Brenner examined some relationships between the El Niño/Southern Oscillation (ENSO) anomalies and wildfires in Florida. He constructed linear correlation coefficients, scatter diagrams, and line graphs to compare acres burned with indexes of central and eastern Pacific sea surface temperature (SST) and sea level pressure (SLP) anomalies. His study revealed a significant relationship between both anomalous SST and SLP in the central and eastern Pacific and acres burned in Florida due to wildfires.

The typical fire season in Florida is from January through May, and the best correlation coefficient ($r = -0.71$) was derived from the average central Pacific SST anomaly during these months, indicating it correlated with up to 50 percent of the variance in acres burned during the years examined. Brenner further suggests that it may be possible to develop a predictive model for wildfire activity in Florida, based on observed SST and SLP anomalies in the central and eastern Pacific.

Table 1—*Monthly averages of fires and Florida acres burned by wildfires, January 1981 to April 1991*

Month	Number of fires (average)	Acres (hectares) burned (average)
January	1,013	32,220 (13,039)
February	1,068	32,963 (13,340)
March	985	39,184 (15,858)
April	721	28,490 (11,530)
May	793	66,256 (26,814)
June	564	28,340 (11,469)
July	432	9,527 (3,856)
August	206	2,826 (1,144)
September	143	1,201 (486)
October	279	2,772 (1,122)
November	246	4,248 (1,719)
December	436	6,713 (2,717)

Table 2—*Linear correlations of Florida acres burned by wildfires and average temperature and pressure indexes for January-May in the central and eastern Pacific between 1950 and 1989*

Average	r correlation	r^2 variance explained
Eastern Pacific SST	–0.60	36%
Darwin SLP	–0.62	39%
Central Pacific SST	–0.71	50%
Standardized Tahiti—Darwin	0.57	31%

Scatter diagrams also show the relationship between the Southern Oscillation and acres burned (fig. 1). The results demonstrate that during La Niña years Florida experienced high acreage burned due to wildfire. Conversely, during El Niño years acres burned due to wildfire dropped well below the mean. However, the scatter diagrams also point to periods of negative anomalies in SST and pressure that did not correspond to above average acres burned. These years generally followed years that correspond to El Niño events of varying intensity. The residual effects from the anomalous rainfall during these events probably reduced the effects of drier conditions associated with periods of below average temperatures and pressures during the following fire season. Time series graphs further demonstrate the relationship between the Southern Oscillation and acres burned annually in Florida. In particular, a significant direct relationship can be seen for the standardized Tahiti minus Darwin SLP indexes (fig. 2).

Figure 3 plots the values for acres burned due to wildfire for every month from January of 1981 through April of 1991 and the index with the strongest simple linear correlation value (r). This figure clearly shows the inverse relationship between the central Pacific SST anomaly and acres burned due to wildfire in Florida.

Discussion and Conclusions

The January through May average central Pacific SST anomaly, when compared with acres burned due to wildfire, results in the strongest linear correlation of any ENSO index. The east and central Pacific SST anomalies, when plotted against acres burned on a month-to-month basis, strongly indicate that during periods when the sea surface temperatures were above the mean, Florida had a "mild" fire season (January through May). The converse is true when the temperatures dropped below the mean. There appears to be some lag in the effects of the positive SST

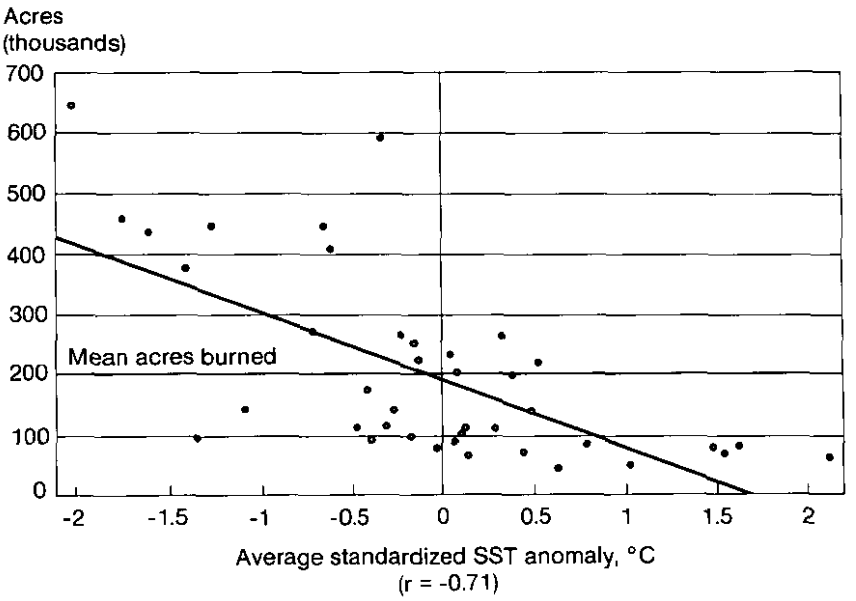

Figure 1—*Scattergram showing the relationship between acres burned by wildfires and the central Pacific surface sea temperature (SST) anomaly (in °C).*

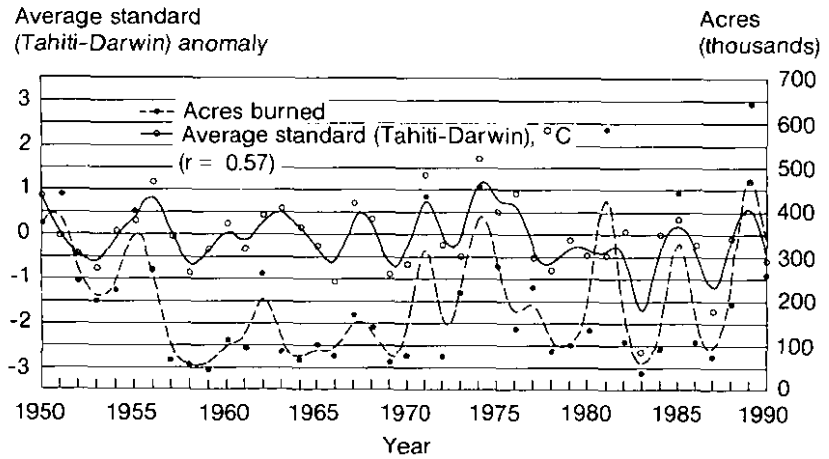

Figure 2—*Line graph showing the relationship between acres burned annually due to wildfires and the standardized Tahiti minus Darwin indexes.*

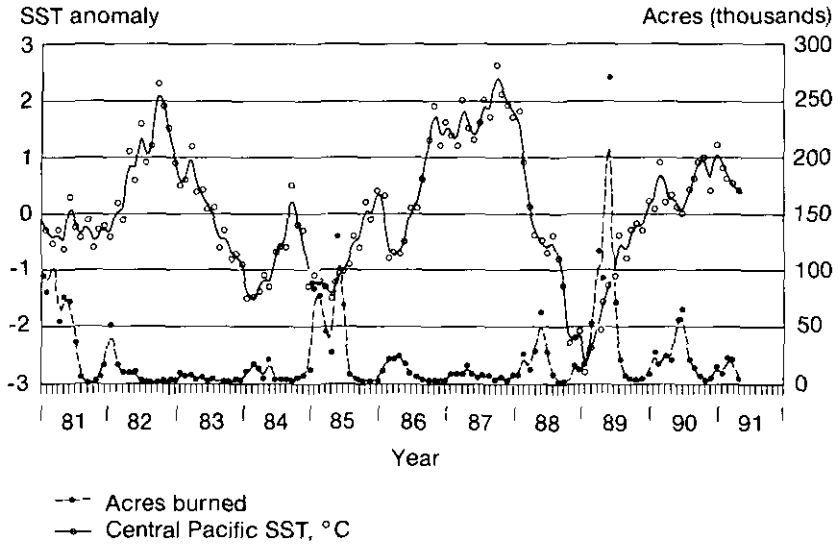

Figure 3—*Line graph showing the monthly values between January 1981 and April 1991 for acres burned and the central Pacific surface sea temperature (SST) anomaly (in °C). The first 5 months of the calendar year are considered the primary fire season.*

anomaly periods, which might help explain years where there were negative anomalies in the SST and sea surface pressure, with no corresponding significant increase in acres burned. The increased rainfall associated with positive anomalies in central and eastern Pacific SST's may be capable of sustaining the system for up to a year after occurrence. This is most likely due to a rise in the level of the aquifier. Lakes, ponds, and swamps will fill and remain full for many months after prolonged wet periods. These wet areas act as natural barriers to the movement of wildfires. A much more significant statistical correlation can be arrived at if the data for the years immediately following the El Niño events were removed.

Periods of negative SST and SLP anomalies (La Niña) in the central and eastern Pacific do not seem to have as prolonged an effect on the system as do the positive El Niño periods. Florida's fire season can be directly correlated with the amount of precipitation received from January through May. Douglas and Englehart (1981) documented the relationship between the central and eastern Pacific SST and SLP and anomalous winter rainfall in the Southeast United States. This teleconnection seems to be linked to large-scale circulation changes associated with anomalous SST and SLP events in the central and eastern Pacific Ocean areas.

Most El Niño-wildfire studies to date have focused on the positive side of the ENSO and its effects on precipitation and wildfire activity. However, this study implies a strong "teleconnection" between the negative SST and SLP events, especially in the central Pacific area. It also suggests that a predictive model could be developed to forecast periods when a significant fire season is likely to occur in Florida.[3]

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[3]The Florida Division of Forestry has contracted with Dr. Timothy Barnett, Scripp's Institute of Oceanography, San Diego, CA, to develop a forecast model for fire season severity in Florida based on ENSO. The USDA Forest Service is funding this research.

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Utah Firefighter Combines Fitness and Fire Training

Because wildland firefighting demands a great deal from the human body, physical fitness training has always been a high priority for suppression crews. But despite training, the weight of a pack, coupled with continuous use of a pulaski or shovel, puts incredible strain on back, arm, and shoulder muscles.

"Normal weight and aerobic training just doesn't prepare a firefighter to use handtools during grubbing and scraping motions over a long period of time," explains veteran Flame-In-Go firefighter Bob Johnson, a member of Utah's inmate fire crew.

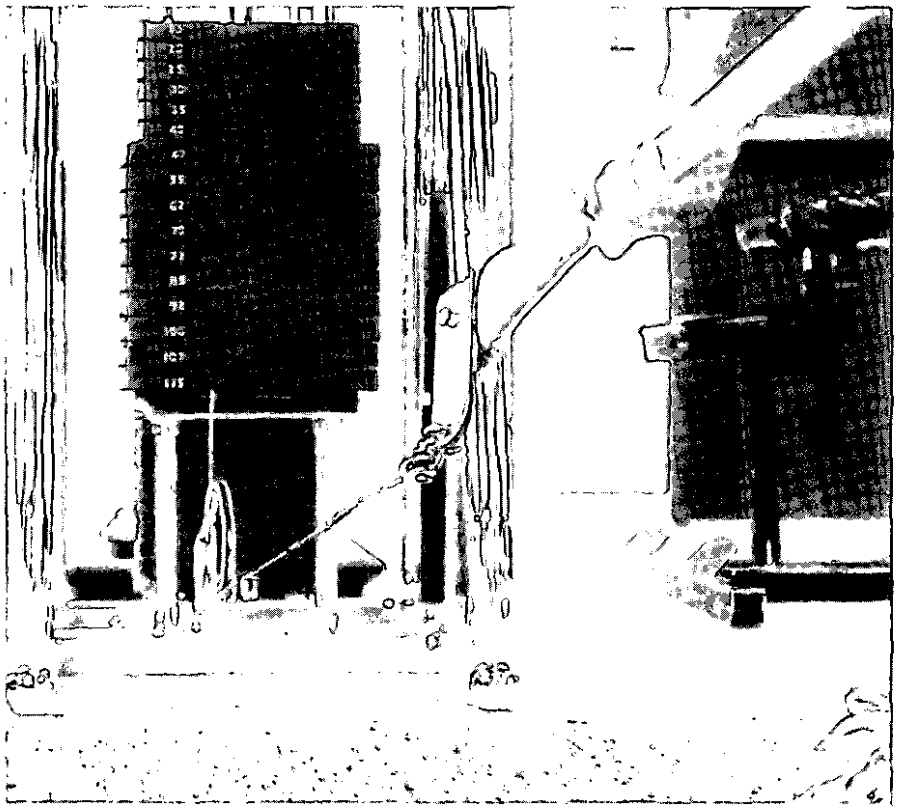
Responding to firefighter complaints about muscle cramps and fatigue, Johnson modified a cable weight machine to help firefighters condition the particular muscle groups critical to pulaski and shovel work. Johnson's device incorporates the resistance of a traditional cable weight machine with proper tool technique. Crews can easily carry out his techniques in their prescason training regimens.

Making the Modifications

Converting the pulaski and shovel into weight-training tools is simple and inexpensive. As the photographs show, both tools are attached to a Universal/Nautilus-type weight-training machine.

The *pulaski cable grub* is built using a new pulaski handle. Install a ¼- × 2-inch (0.64- × 5.1-cm) steel band in place of the pulaski head, using epoxy and a plastic handle wedge to tighten the band. The steel band should extend 2 inches (5.1 cm) on one side. Run a bolt through the band and handle for additional support. Drill a hole in the center of the 2-inch (5.1-cm) extension. Attach the modified pulaski to the weight machine cable with a 1½-inch (3.8-cm) "S" hook.

To construct the *shovel pivot*, simply weld a ¾-inch (1.9-cm) nut to the back of the shovel. Use a 1½-inch (3.8-cm) S hook to attach it to the weight machine cable.



Weight-training machine with pulaski cable grub attached.

Training on the Modified Machine

Using proper form and footing, firefighters can build strength and endurance in back, arm, and shoulder muscles. But remember that in any physical fitness program, warmup and stretching exercises are important. Start slowly with light weights and work up to heavier weights. For each tool, Johnson recommends completing 5 sets of 20 movements using 20 to 25 pounds (9.1 to 11.3 kg.) of resistance.

Following is a possible workout combination using a weight training machine along with the modifications for the pulaski grub and shovel pivot:

Workout movement	*Number*
Overhead press	4 sets of 10 repetitions
Bent-over rows	3 sets of 8 repetitions
Lat pulls	4 sets of 12 repetitions
Seated pulley rows	4 sets of 8 repetitions
Pulaski grub	5 sets of 20 repetitions
Shovel pivot	5 sets of 20 repetitions
Situps	5 sets of 30 repetitions

The pulaski grub and shovel pivot duplicate arm, shoulder, and back motions used on the fireline and enable the firefighter to practice using tools properly while building strength. Back, arm, and shoulder fatigue are partly a function of improper body positioning and tool use. The most rigorous weight and aerobic training will not compensate for improper technique, but combining body motion and proper tool use with weight resistance will help firefighters prepare for line construction. ■

Glenn A. Beagle, *program director, Division of State Lands and Forestry, Lone Peak Conservation Center, Flame-In-Go's, Salt Lake City, UT*

Firefighter working out with shovel pivot.

Self-Paced Forest and Wildland Firefighting Course

A self-paced correspondence course on forest and wildland firefighting is now available through the University of Florida. The course, "Introduction to Forest and Wildland Firefighting," consists of 10 separate units covering the following topics:

- Development of organized fire control
- Introduction to fire behavior
- Firefighting equipment
- Preparedness and initial attack principles
- Fire management and safety
- Fire suppression tactics
- The role of aircraft
- Fire prevention and law enforcement
- Cooperation with rural fire departments
- Administration of a fire control organization

Students will be required to take an examination under supervision when unit assignments are completed. The student earns four continuing education units after successfully completing the course.

Florida Division of Forestry Chief of Fire Control, Michael C. Long, states that "Introduction to Forest and Wildland Firefighting," an approved element in the division's Basic Fire Control Training Program for new Forestry Firefighters, is "an excellent training course, not only for forestry firefighters, but also for municipal and volunteer firefighters and other southern forest and wildland firefighters."

The course, developed by Hugh Mobley (nationally known expert in smoke management and fire behavior) and the Florida Division of Forestry, costs $89.00. This sum includes tuition, study guide, text, and postage. The course text, "Fire Fighter's Guide," and the study guide are sent to students when they enroll in the course. Individuals interested in enrolling should write to James Andrews, Assistant Director, Division of Continuing Education, University of Florida, 1223 NW 22nd Avenue, Gainesville, FL 32609-0089. ■

A New Way to Keep Track of Fire Employees[1]

Katie Mac Millen

Editor, Montana Department of State Lands, Missoula, MT

Computers Can Match Red Card Data to Fire Needs

Not long ago in Montana when fire training officers or supervisors needed to find the right person to fill a vacancy within their agency, they either had to have a first-rate memory or they had to spend hours shuffling through file folders. This is no longer true. Montana's Department of State Lands (DSL) now uses "Redcard Manager"[2] on a personal computer. This program quickly and efficiently matches agency needs with qualifications and goals of personnel.

Redcard Manager (RM) is one of three in a growing system of associated databases including Dispatch Manager and Incident Manager.[3] It was created by Steve Holden and Ray Nelson, DSL's Fire Bureau training officer and computer specialist, respectively, and Jeff Brauer of Montana Software Systems. They've been refining RM since 1984 (see fig. 1).

What Can Redcard Manager Do?

RM uses data from each employee's "Incident Qualification Card" (commonly known as the red card) such as current qualifications, experience, physical fitness, positions targeted, special skills, and training (for example, Emergency Medical Technician certification or training to handle hazardous materials, fig. 2). It evaluates these data to determine whether an employee is qualified for a specific agency position and makes a recommendation about that employee's suitability. RM uses the National Wildfire Coordinating

```
REDCARD MANAGER                          (c) 1990 Montana Software Systems
     Databases Reports Utilities Quit

          Personnel
          Courses
          Classes
          Positions
          Courses Taken
          Experience
          Nominee
          Agency (Redcard)
          Units
          Area

  F1-help    F2-pop    LTR-cmd    ESC-return
```

Figure 1—*Redcard Manager's opening menu.*

```
Personnel Database                              230 Records in use

                Last Name:          Redcard Agency: [      ]
               First Name:                    Unit: [      ]
              Middle Name:                    Area: [      ]
            Unique Number:      Lock Record/Calc For: [  ][  ]
                   Agency:
                   Region:
                              #1     #2     #3     #4     #5
                   Target:   [ ]    [ ]    [ ]    [ ]    [ ]
                Qualified:   [ ]    [ ]    [ ]    [ ]    [ ]
                  Trainee:   [ ]    [ ]    [ ]    [ ]    [ ]
                    Other:   [ ]    [ ]    [ ]    [ ]    [ ]
                 Position:
              Recert Date:

Select: A)dd, F)ind, C)alculate Targets, Y)ear [change], S)tep Test, Q)uit?

Press <ESC> to exit
```

Figure 2—*Screen one of three in the "personnel" database.*

[1]Adapted with permission from the *American Fire Journal*, 1991, 43(4): 12–14.

[2]The use of trade names does not constitute official endorsement of the product by the USDA Forest Service.

[3]Dispatch Manager and Incident Manager borrow RM data to help dispatch to and manage personnel at incidents, but RM's main purpose is to handle personnel data at times outside of incidents.

Redcard Manager quickly and efficiently matches agency needs with qualifications and goals of personnel.

Group's (NWCG's) minimum standards for various positions, but any agency can tailor the program by building in its own standards.

The three developers are the first to tell users that Redcard Manager (RM) is just a tool. The training officer or certifying committee must still use their own judgment after RM makes its recommendations. The RM operator can easily override RM's suggestions; however, there is a comment box available to allow anyone who overrides an RM recommendation to note why RM's suggestions were not accepted. Using this comment box, for example, a training officer could explain that an employee was "grandfathered-in" because he or she had had plenty of on-the-job training and field experience, but had never received formal instruction.

RM Analyzes Agency and Employee Training Needs

Another use of this software is to analyze both the employees' and the agency's training needs. For example, after an employee and his or her supervisor discuss the employee's past experiences and future goals and decide on specific training and experience needed to meet those goals, they can enter these targets into RM. Then when the agency uses RM to update the number of employees it would like to have available for each agency position, the software matches which employees need training in which courses to qualify them at the levels needed by the agency (fig. 3).

If, for instance, an agency decides to add 10 resource unit leaders, the training officer can enter the requirements for that position into RM. The software will then recommend individuals who meet the requirements, and the training officer can add his or her own knowledge in considering RM's suggestions. If the training officer still does not have 10 qualified employees for these positions, it is a simple procedure to check "X–731" and "X–780"—the first two training courses for resource unit leaders—in RM to see who is targeted for resource unit leader. Using RM (combined with firsthand information about an employee), a training officer can successfully match the agency's needs with an individual employee's professional development goals.

Redcard Manager Highlights

- Anyone can look at RM's data
- Operator gets only the data needed
- Operator can make a qualification permanent or revise it as necessary
- RM has "query commands" for frequently made requests
- Operator can ask complex questions by using the optional "Reports" generator (fig. 4)
- Data can be added or updated quickly when employees gain experience or take a course
- Operator can ask for a combination of characteristics to determine all those who meet multiple needs
- Only the training officer or certifying committee can change an individual's qualifications

```
Position Database                                        192 Records in use

                Position: DIVS
             Description: DIVISION/GROUP SUPERVISOR

          Type of Position: [R]                  Physical Fitness: [0]
        Total Trng Hrs Req: 0.00 [ ]                   Months Req: [0]
Experience Requirements
               Mgmt. Level: [0]                    Req. Numbers: [32]
               Exper. Type: [B]                    Recert Months: [24]
         Performance Rate: [0]                       Recert Kind: [U]
                 Fire Type: [B]
          Pass/Fail Percent: [0]

Above Positions:  [OPSL]  [     ]  [     ]  [     ]  [     ]
Below Positions:  [TFLD]  [STLD]  [STCR]  [STEN]  [STDZ]
Curr. Positions:  [TFLD]  [STLD]  [STCR]  [STEN]  [STDZ]  [     ]  [     ]

Find: N)ext, P)revious, C)orrect, 1) Screen, 3) Screen, Q)uit?

Press <ESC> to exit
```

Figure 3—*Screen one of three in the agency "position" database.*

Applications of the Software

The RM creators consulted widely within and outside the DSL to develop and refine the software. They learned the kinds of questions people actually had and included those customer specifications in RM (fig. 4). They also wanted to make the software expandable—RM can continue to grow as the data grow, even when other agencies' data are incorporated. RM is not public domain software; it is available for $895 from Montana Software Systems, P.O. Box 4074, Missoula, MT 59806. ■

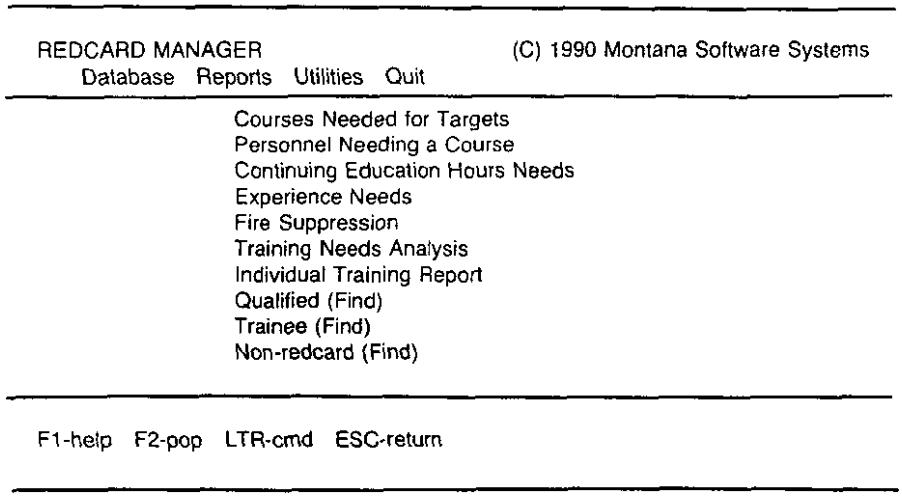


Figure 4—*The "Reports" menu that lists frequently made queries for specific data groupings.*

Ten-Percent Rule for FEPP

In recent *Fire Management Notes* articles (see "Author Index—Volume 51," this issue), I've been explaining the rules and the law that gives the USDA Forest Service the authority to loan Federal Excess Personal Property (FEPP) to State Foresters. Briefly, when States use FEPP for fire protection, State Foresters are not required to pay a 25-percent surcharge into the U.S. Treasury. Federal and State employees who manage FEPP also need to know about the 10-percent rule. This important rule limits nonfire use to 10 percent of the total use during a 12-month reporting period or a multi-year review period.

What Happens to Rulebreakers?

Abuse of the 10-percent, nonfire use standard could result in recall of the property on loan, suspension from the program, or other sanctions.

Who's Responsible?

The State Forester, regional property management officer, and the FEPP manager are responsible for making certain that FEPP is not put to personal use. In fact, they are expected to monitor closely use of FEPP housetrailers, communications equipment, photographic equipment, movable buildings, boats, and aircraft to ensure that this property is used as authorized.

Exception to the Rule

State Foresters use FEPP primarily for fire protection; however, situations do occur that make this exclusive use impractical. For instance, FEPP may be used during emergencies when there is a threat to life and property. In these cases, the FEPP program manager may authorize use of FEPP equipment for activities other than fire protection—but only when abnormal wear and tear of the FEPP will not occur. Such authorizations, incidentally, should not be used as "loopholes." If nonfire use will exceed 10 percent of total use, the State Forester must justify it in writing to the USDA Forest Service regional or area FEPP manager.

To Repeat the 10-Percent Rule

State Foresters desiring FEPP that will not meet the 10-percent standard should acquire that FEPP through a Federal sponsor other than fire management, and they should pay the 25-percent surcharge. Nonfire use of FEPP is limited to 10 percent of the total use. ■

Francis R. Russ, *property management specialist, USDA Forest Service, Fire and Aviation Management, Washington, DC*

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The Pine Tree Shield—Serendipitous Design, Enduring Symbol[1]

The coniferous tree on the center of a shield, surrounded by the letters "U" and "S," the words "Forest Service" and "Department of Agriculture" just "sort of happened." The origin of the Forest Service badge is a story of foresters-cum-design ideas.

In 1905, the administration of the forest reserves was transferred from the Department of the Interior to the Department of Agriculture. What had been known as the Division of Forestry would now be called the Forest Service. At the time of this transfer, perhaps because of it, a design contest was organized to create a new symbol of authority, replacing the round nickel badge worn by General Land Office forest reserve officers.

The contest judges, then Chief Forester Gifford Pinchot, E.T. Allen, and Overton W. Price, did not find an acceptable design among those submitted to the contest and set about to organize a new competition—this time with guidelines. The base of the badge should be a shield, they decided, an ancient symbol of authority. From a railroad time schedule lying on his desk, E.T. Allen traced a shield, inserting the letters "U.S." across the shield's center. William Hodge, present during the discussion, sketched a pine tree on a cigarette paper and placed it between the two letters. In the next minute someone had written "FOREST SERVICE" above the tree and "DEPARTMENT OF AGRICULTURE" beneath it. Immediately, the judges realized this 3-minute mock-up met their criteria for a design, and they canceled the second contest. The symbol designed that day has been enduring—86 years old in this centennial year of the first forest reserves. ■

Doris Celarier, *editor, USDA Forest Service, Public Affairs Office, Washington, DC*

[1]Information was gathered from "The Shield and the Tree," American Forests and Forest Life, July 1930, p. 392; "The Forest Service Badge," an unpublished narrative, History Section, Washington, DC, May 1972.

"Watch Out!" Situations

1. Fire not scouted and sized up.
2. In country not seen in daylight.
3. Safety zones and escape routes not identified.
4. Unfamiliar with weather and local factors influencing fire behavior.
5. Uninformed on strategy, tactics, and hazards.
6. Instructions and assignments not clear.
7. No communication link with crew members/supervisors.
8. Constructing lines without safe anchor point.
9. Building fireline downhill with fire below.
10. Attempting frontal assault on fire.
11. Unburned fuel between you and the fire.
12. Cannot see main fire—not in contact with anyone who can.
13. On a hillside where rolling material can ignite fuel below.
14. Weather is getting hotter and drier.
15. Wind increases and/or changes direction.
16. Getting frequent spot fires across line.
17. Terrain and fuels make escape to safety zones difficult.
18. Taking a nap near the fireline.

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