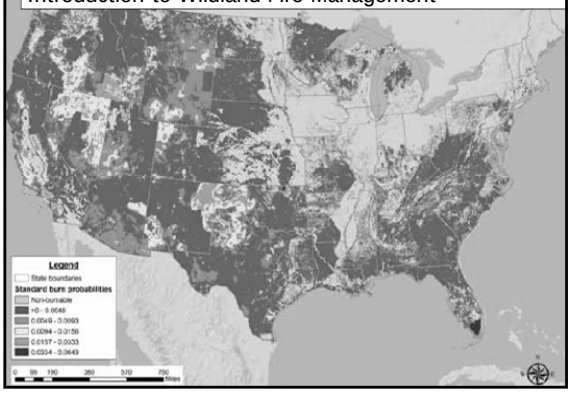
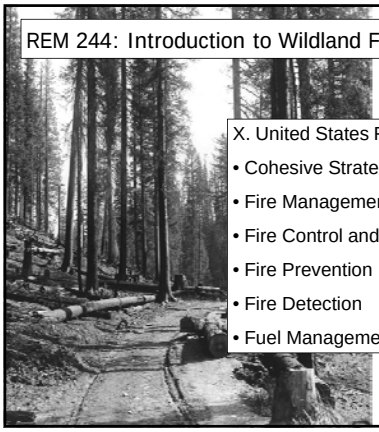
Introduction to Wildland Fire Management



REM 244: Introduction to Wildland Fire Management



X. United States Fire Management

- Cohesive Strategy
- Fire Management Economics
- Fire Control and Fire Use
- Fire Prevention
- Fire Detection
- Fuel Management

REM 244: Cohesive Strategy

The organization of fire management in the United States includes a federal system that acts a foundation for a national system upon which state, local, private agencies build upon (Pyne et al 1996).

Federal Fire Management Agencies

- U.S. Forest Service: *National forests and grasslands*
- Bureau of Land Management: *Unclaimed public domain lands in the West and Alaska*
- National Park Service: *National Parks*
- Bureau of Indian Affairs: *Indian reservations*
- Fish and Wildlife Service: *Wildlife refuges*
- Military Services (DoD): *Military bases*

The different fire agencies focus on their individual mandates.

Rx Fire at Eglin AFB, Florida (Smith).
Sources: Pyne et al (1996)

REM 244: Cohesive Strategy

Arising from the recognition that fires will cross jurisdiction boundaries, a series of interagency wildland fire management federal organizations were established.

- National Wildfire Coordination Group (NWCG): via a series of committees sets national standards and guidelines such as certifications via the National Interagency Fire Qualifications System.
- National Interagency Fire Center (NIFC): consolidates logistical support
- National Advanced Resources Technology Center (NARTC): hosts high level trainings
- Fire Weather Service

Source: http://www.forestsandrangelands.gov

REM 244: Cohesive Strategy

Through early initiatives such as Fire Program Analysis (FPA), the different agencies have started to work together to formulate national fire planning and budgets.

2009: Federal Land Assistance, Management, and Enchantment (FLAME) Act directed the Wildland Fire Leadership Council (WLFC) to develop a single, "Cohesive Strategy" to enable multiple agencies, NGOs, and the public to solve national (all land) solutions to wildland fire management issues.

2011: National Cohesive Wildland Fire Management Strategy guiding document released.

Source: http://www.forestsandrangelands.gov

REM 244: Cohesive Strategy

Cohesive Strategy is considered a national priority as:

a. Fires can cross multiple jurisdictions (agency, state, private, etc)
b. The significant drivers of fire management policy (climate, protecting highly valued resources, and managing fuels) are important to all agencies.
c. There are currently large differences in the philosophy, funding, culture, and mission of the different fire management agencies and NGOs.

House with the perimeter of the Fourier Canyon Fire. The fire destroyed 170 houses, but this one survived due to good design.
Source: http://www.forestsandrangelands.gov

REM 244: Cohesive Strategy

The FLAME Act requires that the "Cohesive Strategy" is revised and updated every 5 years. This allows the strategy to account for changes in climate, vegetation, and landscapes.

Governance: the USDA and DOI delegated oversight to the Wildland Fire Leadership Council (WFLC), which is an intergovernmental organization of federal, state, tribal, county, and local officials.

The Wildland Fire Executive Council (WFEC) oversees the implementation. Regional strategy committees will act under this council and be established for each region of the country.

The goal is a new approach that includes the multiple missions and gives a voice to all the involved partners.

Source: http://www.forestsandrangelands.gov

REM 244: Fire Management Economics

Historically wildland fire economics has focused on three general concepts: costs based on adequate protection. Costs based on minimizing damage, and minimizing the sum of costs plus losses.

Adequate Protection: The cost of fire suppression should equal the total cost that a reasonable person would be willing to pay out in insurance if the fire burned.

This concept was proposed for high value forests where market value could be easily calculated.

The approach did not work where values were important (wildlife refuges, BAI land, etc) but could not be readily given a market value.

Sources: Pyne et al (1996), wildfirelessons.net

REM 244: Fire Management Economics

Historically wildland fire economics has focused on three general concepts: costs based on adequate protection. Costs based on minimizing damage, and minimizing the sum of costs plus losses.

Minimum Damage: This theory assumes that agencies should aim to keep cost of damages (via burned area) to a minimum.

This concept generally set % targets that are allowed to burn within a management area.

This approach is considered useful when developing a planning budget for an area that has not had a formal budget process developed.

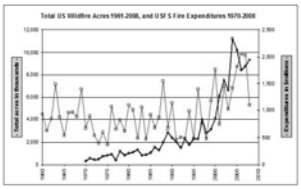
Sources: Pyne et al (1996)

REM 244: Fire Management Economics

Historically wildland fire economics has focused on three general concepts: costs based on adequate protection. Costs based on minimizing damage, and minimizing the sum of costs plus losses.

Cost-Plus-Loss: This economic theory incorporates both suppression expenses ("costs") and the short- and long-term damages to property ("losses"). The approach seeks to find when this sum is at a minimum.

This is the preferred economic theory behind fire managements costs.



Sources: Pyne et al (1996), wildfirelessons.net

REM 244: Fire Management Economics

When considering the "cost-plus-loss" $ estimates of large wildland fires, it is clear that the suppression cost represents only a very small proportion of the total fire $ bill.

2000 Cerro Grande Fire: suppression costs ~ 3% of total estimate.

2002 Hayman Fire: suppression costs ~ 18% of total estimate.

2003 Grand Prix and Padua Complex Fire: suppression costs ~ 7% of total estimate.

Zybach et al (2009) showed that in many cases suppression costs are only ~2% of total estimates

The Pacific Crest Trail (2004) – B. Zybach
Sources: Zybach et al (2009): wildfirelessons.net

REM 244: Fire Management Economics

It is important to understand what constitutes typical "costs and losses" in wildland fires (from Zybach et al 2009):

1. Direct Costs. Suppression and wildfire related expenses occurring at time of fires (evacuations, business and school closures, direct damage to property and homes, etc)
2. Indirect Costs. Fire crew training and equipment, changes to insurance premiums, devaluation or destruction of past work (land management treatments, crops, reforestation, etc), lowered recreation value, etc.
3. Post-fire Costs. Long-term damages to public and the environment: loss of timber values, crops, homes, and public/private equity.

Sources: Zybach et al (2009): wildfirelessons.net

REM 244: Fire Management Economics

The principal challenge with the Cost-Plus-Loss theory is that although suppression cost is well documented it is difficult to define the actual losses caused by the fire.

- It is also very difficult to robustly link fire prevention, fuels management, or fire suppression investments to any given quantifiable $ return.
- The theory typically does not include that fires can improve future land values (so gains rather than losses). Difficulties in predicting long-term fire effects, lead to more difficulties.

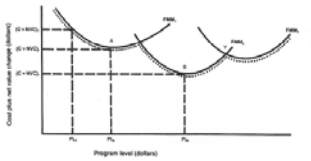
Sources: Pyne et al (1996), wildfirelessons.net

REM 244: Fire Management Economics

All of the federal fire agencies apply economics as part of fire management planning. The most commonly applied approach is a variant of Cost-Plus-Loss called the National Forest Management Analysis System (NFMAS).

The core of NFMAS is a cost-plus-loss model that has been modified to "cost plus net value change".

The advantage of this modified system is that it can be extended over multiple fire management units where a global minimum can be calculated.



Sources: Pyne et al (1996), wildfirelessons.net

REM 244: Fire Management Economics

Fire Program Analysis (FPA) seeks to

"Develop a comprehensive interagency process for fire planning and budget analysis identifying cost-effective programs to achieve the full range of fire management goals and objectives."

1. Create ignition probabilities based on historic data.
2. Evaluate how these probabilities change with fuel treatments.
3. Fire growth and spread is modeled. If fires > 300 acres they are modeled further over weeks.
4. The costs of all large fires are calculated.
5. Dispatch and management actions are modeled. Cost scenarios are used to inform federal budget planning.

Source: FPA Science Team

REM 244: Fire Control and Fire Use

For a national fire management program to succeed, whether it is policy driven (cohesive strategy) or budget driven (FPA), all the strategies that can be applied within that program must be understood both individually and as a whole.

When considering "fire control", there are multiple approaches to prevent unwanted ignitions.

The National park Service and Fish and Wildland Service manage fires via "multiple objectives"; whereas in many ways the U.S. Forest Service remains suppression driven.

Accepting that different approaches exist is necessary in any national fire management program.

Rx fire in Georgia (Smith).
Sources: Pyne et al (1996)

REM 244: Fire Control and Fire Use

In order for a truly cohesive fire management program to work effectively, all the varying components that it comprises of must individually work and also operate seamlessly as a whole.

As noted earlier, the U.S. Forest Service is prominently fire control driven, other agencies are more comfortable with fire use. Each of these has its on distinctive approach and specialized personnel.

Thus the challenge becomes how to account for these vast philosophy differences within a common equipment and incident command infrastructure?

Rx fire in Georgia (Smith).
Sources: Pyne et al (1996)

REM 244: Fire Control and Fire Use

The strategy of Fire Control is defined as methods that prevent unwanted ignitions.

Fire control can be achieved by

1. Modifying the environment where the fire burns (fuels treatments, biomass removal, construction of fire breaks, etc.,)
2. Suppressing all small fires before they become large (and perhaps uncontrollable) fires.
3. Responding appropriately to escapes and large fires

Biomass removal to reduce hazardous fuels, USFS
Sources: Pyne et al (1996)

REM 244: Fire Control and Fire Use

The strategy of Fire Use is defined as methods that substitute prescribed fires for opportunistic wildfires and that use other prescribed fires to forward land management objectives.

In order to "make use of opportunistic wildfires (wildland fire use)" or "prescribed fires" for fire use you first have to have control of fires. Thus although opposite approaches they are linked.

Each of Fire Control and Fire Use employ similar pre-planning efforts, fire control tactics, and land management objectives.

Each uses the commonly trained NWCG workforce and each relies on continual advances from the fire research community.

Northwest Crown Fire Experiment, Northwest Territories, Canada
Sources: Pyne et al (1996)

REM 244: Fire Control and Fire Use

Fire use modules (FUM) are typically a 7-11 person team that have qualified as Fire Effects Monitors. The role of FUMs are primarily backcountry observation and tactical operations.

During the active wildfire seasons, FUMs are commonly assigned to wildfires that are being managed to burn with little or no human intervention. Outside of the wildfire season, FUMs are often used to implement prescribed burns. FUMs observe fire activity and weather, and they work to protect certain resources threatened by fire.

1995: NPS founded the fire modules at five different National Parks / monuments. FUMs are funded and supported by the National Park Service, the USFS, the BLM, and also by The Nature Conservancy.

2010: 17 different FUMs existed nationally.

TNCs Fire Use Module
Sources: Heward (2010), Pyne et al (1996)

REM 244: Fire Prevention

The strategy of Fire Prevention is defined as methods that seek to eliminate unplanned and accidental fires. The main challenges of fire prevention are that its simply not possible to eliminate all fires; and many fire that can be eliminated could have positive ecological impacts on the environment.

A further challenge is that human based ignitions can only be fully prevented with:

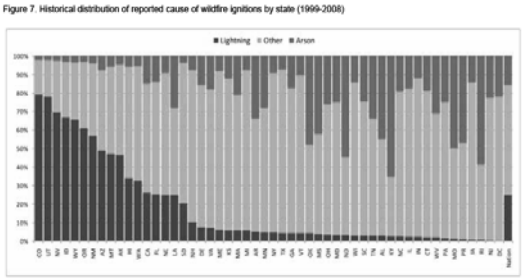
- No crime or accidents and
- Policy that prohibits certain activities of fires occurring
  - banning non-FIREWISE homes
  - banning campfires
  - banning fireworks
  - etc

Clearly this is not a feasible enterprise in a democracy.

National Fire Ignition Probability
Sources: Pyne et al (1996), FPA

REM 244: Fire Prevention

Effective prevention relies on first knowing the cause of ignitions and the probability of those fires occurring again.



Historical Fire Ignitions (1999-2008), Sources: Pyne et al (1996), FPA

REM 244: Fire Prevention

Clearly the "other" category is quite large. The USFS uses a list of several "causes".

US Forest Service Ignition Causes:

- Lightning: direct or indirect
- Equipment Use: direct use
- Smoking: cigarettes, matches, pipes
- Campfire and Recreation: escapes
- Debris Burning: escapes
- Railroad: sparks
- Arson: on purpose ignition
- Children: accidents
- Forest Utilization: harvesting,
- Miscellaneous : other known cause

Once causes are identified, education and further public message campaigns are often a route to increase future prevention.

Sources: Pyne et al (1996), Images from smokeybear.com / USFS

REM 244: Fire Detection

The goal of Fire Detection is to identify an ignition as quickly as possible so that actions can be implemented while the fire is small and manageable.

Patrols: This is the oldest form of detection.

Fire Lookout Towers: Multiple towers that each gave azimuth readings to fires, enabled fire locations to be triangulated on a map at a central location.

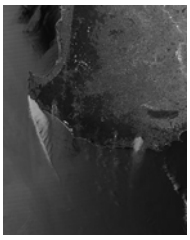
Aerial Detection: Aircraft patrols used pigeons before radio communication.

In cases were continuous coverage is needed, lookout towers were used; with aerial detection used for intermittent coverage is adequate or when towers can not be build (e.g., wilderness areas).

Sources: Pyne et al (1996), wikipedia

REM 244: Fire Detection

Recent years has seen the wide-spread adoption of geospatial technology to assist in fire detection. Real time aircrafts or unmanned aerial vehicles with thermal infrared cameras and near-real-time satellites allow fires as small as 40x40 feet to be accurately located.



MODIS 4-daily active fire detects. Global product (NASA)

GIS map of daily large fire incidents (NIFC)

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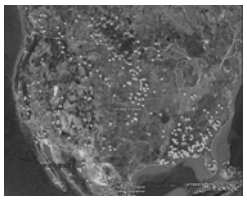

Hazard Mapping System for Fire and Smoke (NOAA / Google)

GIS map of daily large fire incidents in Canada (USFS / CFS)

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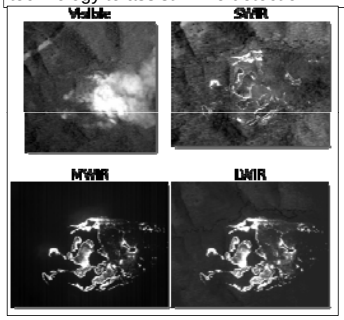

Aerial IR images of a forest fire, RIT

REM 244: Fuel Management

The goal of Fuel Management is to modify the fuel such that you manipulate the resulting fire behavior and effects and in turn reduce the cost of fire suppression.

Fuel Reduction includes any approach that seeks to reduce fire hazard through lowering the fuels available to burn.

Fuel reduction methods can include: chipping fuels following a thinning, mastication, mechanical removal, and prescribed fires.



REM 244: Fuels Management

Fuel Conversion (cover type conversion) assumes that different species will promote different fire regimes.

Conversions can include changing brush to grass, or forest to meadow. In many cases it has happened "accidently due to fire exclusion", leading to unexpected changes in fire behavior.

A ponderosa pine stand in the Bitterroot National Forest in Montana in 1909, 1948, and 1989
Sources: Pyne et al (1996), wikipedia

REM 244: Fuels Management

Fuel Isolation includes approaches that remove high hazard fuels from high value resources.

Firebreaks, greenbelts, defensible space, and designs using non flammable materials are excellent examples of fuel isolation.

Sources: Pyne et al (1996)