Integrating Fire History and Fire Management: Establishing Reference Conditions and Monitoring Process, Sequoia and Kings Canyon National Parks

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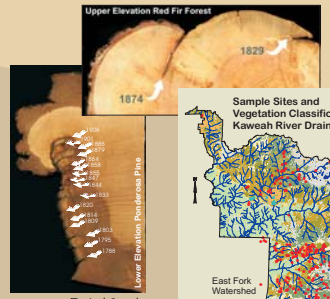
ABSTRACT

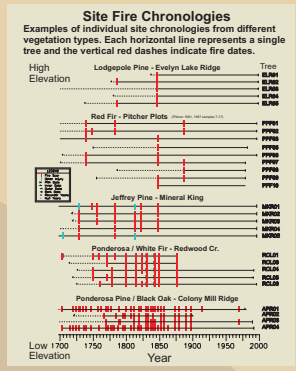
To fulfill their mission to preserve natural ecosystems, it may be necessary for parks to restore forests perturbed by fire suppression. In Sequoia and Kings Canyon National Parks, the loss of fire as a keystone process has resulted in significant ecosystem changes. While fire's role is being restored in the parks, specific targets have remained elusive because of inadequate baseline information about historic fire regimes. Restoration goals and our achievements can be enhanced by improving our understanding of historic reference conditions and range of the variability of past fires. To accomplish this within forested landscapes of the parks, attributes of past fire regimes are being reconstructed through dendrochronological analysis of fire scarred trees. Results will provide information by forest type on fire frequency and its variation with topography and climate. A GIS "ecological needs" model is then being utilized to integrate this information into fire management planning and to monitor fire's restoration.

Introduction

Until recently the direct utilization and integration of fire history data into resource and fire management planning and operations has been minimal. Most data sets were simply viewed as providing evidence of fire occurrence with some idea of its frequency. However, over the last decade as fire history data sets have improved, applications are being developed. An approach currently being utilized in Sequoia and Kings Canyon National Parks has sought to characterize fire regime attributes (process) coupled with forest structure characteristics for all the major vegetation classes, using the best sources of information, and then integrating this with the fire planning decision process. The generalized methods being used are described by this poster.



Typical Samples

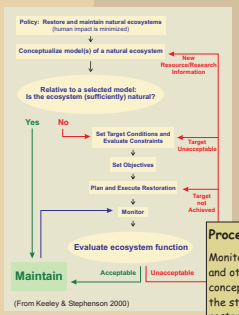


Target Conditions - Process (Examples)

Vegetation Type	Fire Return Interval Range	Season of Fire % of area burned)
Ponderosa Pine- Mixed Conifer	1-15 years (mean = 4, R_{obs} = 4) quality – good	0-20% Jun-late Aug 50-70% late Aug-Oct 30-50% Oct-Dec
Giant Sequoia-Mixed Conifer	1-30 years (mean = 10, R_{obs} = 14) Quality – good	0-20% Jun-late Aug 40-60% late Aug-Oct 30-50% Oct-Dec
Subalpine	50-600 years (mean = 197, R_{obs} = 508) quality – poor	0-5% Jun-Jul 90-100% Aug-Oct 0-5% Nov-Dec
Lodgepole Pine	9-164 years (mean = 100, R_{obs} = 163) Quality – very poor	0-10% Jun-Jul 80-90% Aug-Oct 0-10% Nov-Dec

Sampling, Analysis & Setting Target Conditions

- Fire scar samples (panel far left) are obtained from replicate sites located within the major conifer forest vegetation types (left center).
- Dendrochronological analysis provides calendric fire dates with precise temporal and spatial resolution.
- Fire regime attributes (fire return interval, interval variation, season, etc.) are estimated for the pre-Euro-American period (prior to 1860)(near left).
- Information is used to derive **target conditions** (above).



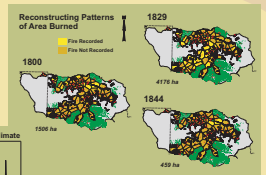
(From Keeley & Stephenson 2000)

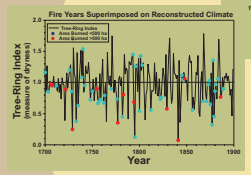
Monitoring: Process and Structure

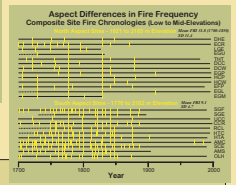
Process Monitoring

Monitoring of fire as a ecological process uses FRID and other fire regime attribute models/data. The conceptual model at left shows a decision tree of the steps and linkages used in implementing restoration and in monitoring ecological function.

Pre-Euro-American
Fire History
Determining Target Conditions



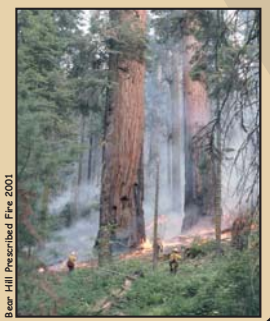




Other Fire Regime Attributes

Advances in fire history sampling and analysis methodology are allowing other fire regime attributes to be acquired including:

- fire climate relationships (panel above left)
- fire size, largely unknown from high frequency or understory fire regimes (top panel)
- Landscape variation in past fire frequency occurrence (lower panel above - shows differences between N vs S aspects in similar vegetation)


Bear Hill Prescribed Fire 2001

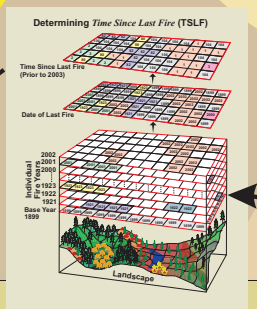
Fire Planning & Execution

Other Operational Inputs
Smoke + Budget + Workforce + Misc. Constraints

Other Resource Inputs
Forest Structure + Fire Effects

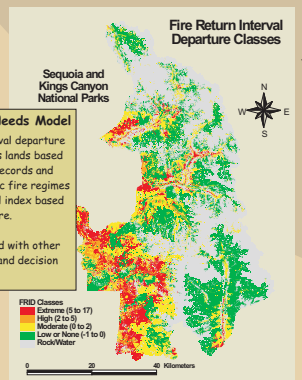
Integration with Other GIS Inputs
Hazard (fire behavior characteristics) + Risk (probability of fire starts) Models

GIS



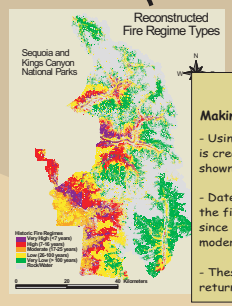
Base Year

TSLF - FRI / FRI



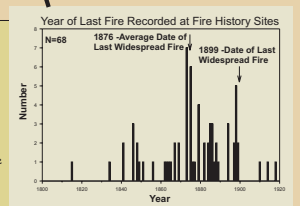
FRID: Ecological Needs Model

- The fire return interval departure (FRID) model classifies lands based on contemporary fire records and departure from historic fire regimes to provide an ecological index based on a need to restore fire.
- FRID can be combined with other fire models using GIS and decision support tools.



Making Maps Out of Tree Rings

- Using GIS a geospatial representation of fire regimes is created by vegetation type (frequency classes shown at left).
- Date of last widespread fire (right) is determined from the fire chronologies and becomes the base year for the time since last fire (TSLF) GIS layer (top) which integrates modern fire records/maps (since 1921) into a GIS layer.
- These two data sets are combined to create a map of fire return interval departures and an index of "ecological need".



Acknowledgements

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Image at center by SEKI fire monitors of a 2002 prescribed fire in Grant Grove.

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