Wildfire Threat to Ecosystem Health and Community Safety

Methodology

Three unique FRAP analyses were conducted in this chapter to address wildfire related impacts in California. Two of these analyses address ecosystem health and one analysis addresses threats to public safety, private property, and community infrastructure.

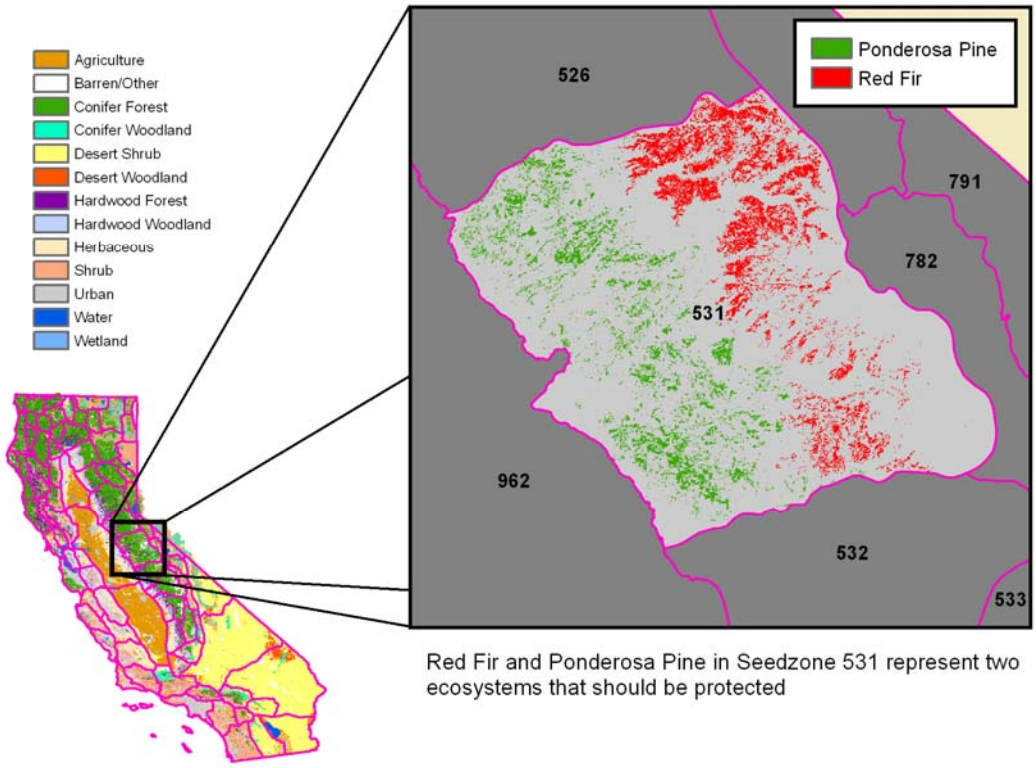
Key Concepts:

Key concepts explain the ecosystem and community assets and how they are used in these three analyses.

Ecosystems

Ecosystems as defined in this chapter refer to unique vegetation (WHR) types by tree seed zones (Figure 1).

Figure 1. Land cover and tree seed zones in California.



Red Fir and Ponderosa Pine in Seedzone 531 represent two ecosystems that should be protected

Tree seed zones help determine the suitability of seed for planting and survival in a particular area. These zones are areas with similar climate and soils and are delineated on the basis of collection criteria adopted by the USDA forest seed policy of 1939 (Fowells, H. A. 1946). When combined with vegetation maps, tree seed zones define unique ecosystem assets and represent areas potentially having unique genetic resources.

Landscape-Level Damage and Threat

The approach taken in these analyses recognize that stand-level threats and damages have elevated importance if cumulatively they have potential to do damage to broader landscape-level ecosystems. While stand-level impacts can result in various damages to ecosystem attributes, a landscape-level event can have a significant impact on larger systems, for example loss of genetic diversity for a given tree species, or decline of a particular wildlife species due to loss of localized habitat. Effectively, higher priority is given to damages or risks in ecosystems that have been heavily damaged, or have high risk of future damage.

Communities

Communities are a specific GIS polygon dataset used as a reporting unit for assessing impacts to human infrastructure and are based on both legal jurisdiction areas (incorporated cities) and areas identified as “places” in the 2000 census data.
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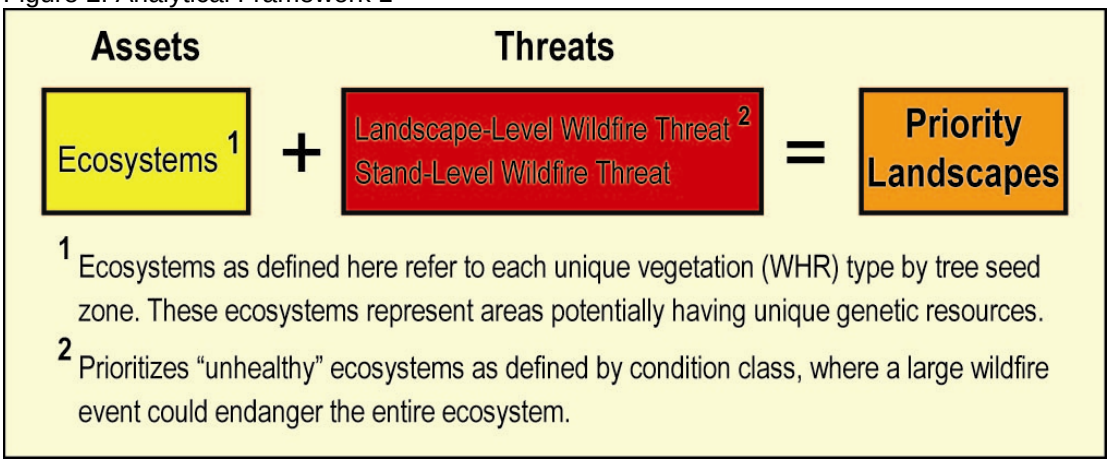
Analysis #1: Preventing Wildfire Threats to Maintain Ecosystem Health

Figure 2: Analytical Framework 1



Assets:

This analysis uses ecosystems as defined above in Key Concepts as the basis for assets subject to wildfire threats.

Threat: Stand-Level WildfireThreat

Threat data developed for this analysis is based on estimated fire frequency and fire behavior characteristics at a fine granular (30 m grid cell) scale. For this, we used FRAP's Fire Threat data set (fthreat05_1), with the threat attribute reclassified from four classes into three according to the following rule set:

Threat	Stand-Level Threat
1 Moderate	1 Low
2 High	2 Medium
3 Very High	2 Medium
4 Extreme	3 High

Areas not covered by wildlands (e.g., urban areas, agriculture, etc.) were omitted from the analysis

Threat: Landscape-Level Wildfire Threat

This threat layer measures the risk of widespread landscape-level damage to an entire ecosystem. For each ecosystem, we calculate the percent of the acreage that is "unhealthy" based upon the percentage of the ecosystem that has a Condition Class value of either 2 or 3 (ie at risk of losing some key ecosystem components/functions), using the California Fire Regime–Condition Class data

developed at FRAP (FRCC_03_1). The proportions used to classify landscape-level threat are as follows:

% unhealthy	Rank
<50%	1
50% - 90%	2
>90%	3

All non-wildland ecosystems were assigned a value of zero, and consequently excluded from the analysis.

Priority Landscapes (PL)

The combination of threats (stand-level threat and landscape-level threat) produced a 2-way matrix for determining the final priority landscape (PL) ranking;

		Stand-Level Threat Rank				
		0	1	2	3	
Landscape	0 |	0	0	0	0	
Threat	1 |	0	1	2	2	Priority Landscape Rank
	2 |	0	2	3	3	
Rank	3 |	0	3	3	3	

Subject to the following exceptions: For all ecosystems based on WHR types 12 and 34 (Chemise-Redshank Chaparral and Montane Chaparral, respectively) any cells resulting in a preliminary PL rank of 3 according to the matrix above were recoded to a value of 2. The rationale for this adjustment was the relative sensitivity of the landscape threat data built from condition class as based on the proportion of land in condition class two and three, and that much of these ecosystems were originally classified as condition class 2. It is our belief that these hard chaparral ecosystems in general do not warrant assignment of high priority, and this adjustment was the most effective way to improve the analysis.

Priority landscape data was then overlaid against a variety of reporting units (e.g. county, HUC8 watershed, bioregion) for the purpose of summarization.

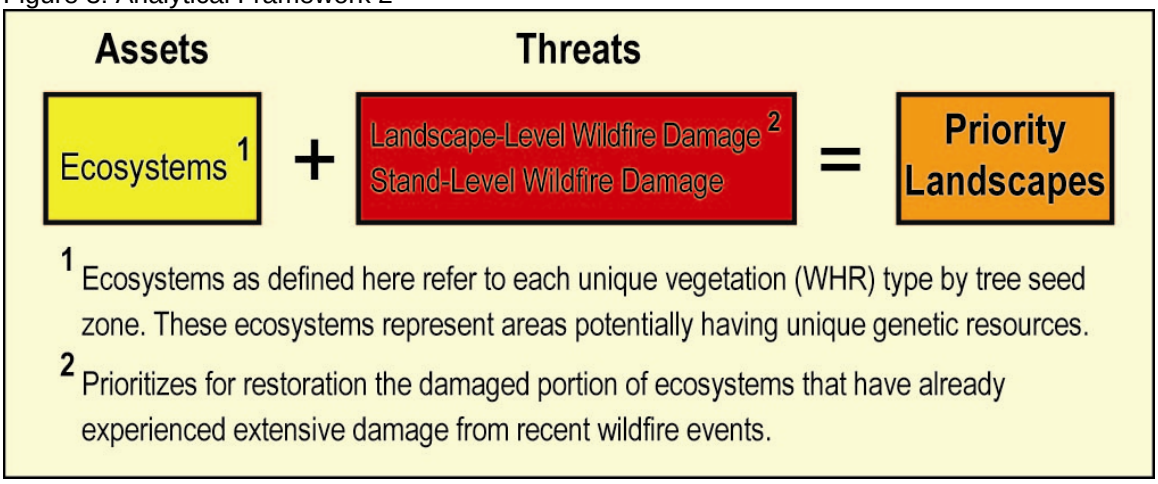
Data Used in the Analysis

The datasets used in this analysis are available at http://frap.fire.ca.gov/assessment2010/2.1_fire_threat.html. These are provided to document the analysis, and to provide the potential to replicate results. Updated versions of these datasets may be available from the various data providers.

ANALYSIS: Preventing Wildfire Threats to Maintain Ecosystem Health			
Data theme		**Dataset name**	**Purpose**
THREATS			
THREAT1: Stand-level Wildfire Threat		thr_wfireSTrisk09_1.gdb	Wildfire threat ranks based on expected fire frequency and severity
Inputs	Fire threat	input_fthreat05_1.gdb	Fire threat based on fuel rank and fire rotation
THREAT2: Landscape-level Wildfire Threat		thr_wfireLSrisk09_1.gdb	Ranks areas based on percent of ecosystem that is in an “unhealthy” condition
Inputs	Condition Class	cafrcc03_2.gdb	Input dataset used to define condition class for calculating percent of each ecosystem that is in an “unhealthy” condition
ASSETS			
ASSET1: Ecosystems		ast_ecosystems09_1.gdb	Ecosystems defined by each tree seed zone/vegetation (WHR) type combination
Inputs	Tree Seed Zones	input_seedzones02_1.gdb	Tree seed zones used to define ecosystems
	Vegetation	input_fveg06_2.gdb	Vegetation (WHR) types used to define ecosystems
PRIORITY LANDSCAPE			
PL: Preventing Wildfire Threats to Maintain Ecosystem Health		pl_t21_a109_2.gdb	Priority landscape for preventing wildfire threats to maintain ecosystem health
OTHER DATA			
Bioregions		INACCBioreg04_1.gdb	Reporting unit for summarizing results
Ownership		owner9group09_1.gdb	Used to report results by major ownership group
Counties		cty24k09_1.gdb	Reporting unit for summarizing results
HUC8 Watersheds		wbd09_1.gdb	Reporting unit for summarizing results

Analysis #2: Restoring Wildfire-Impacted Areas to Maintain Ecosystem Health

Figure 3: Analytical Framework 2



This analysis identifies priority landscapes in ecosystems already subject to wildfire damage directly due to recent fire activity.

Assets

Ecosystems are defined as in Analysis 1.

Threat: Stand-Level Wildfire Damage

Stand-level wildfire damage is designed to reflect direct impacts of recent wildfires. These data are compiled from fire severity data for fires that are 7 years old or less. Where we have fire perimeters, but no fire severity data, the pre-burned fuel hazard rank data from Fire Threat was used to infer severity class, hence stand-level damage. Both of these data sets employ a three-class, Low-Medium-High schema. Final stand-level ranking was determined based on a two-way matrix with number of years since the fire, where more recent fires reflect a higher threat level.

Specific steps:
1) Use vegetation burn severity data from the USFS (http://www.fs.fed.us/r5/rsl/clearinghouse/gis-download.shtml#burnseverity), select fires from the years 2002-2008. Rank fire severity for burned areas represented here.
2) Use CA fire plan fuel rank (frnk02_2) data as a proxy to estimate 'expected' fire severity for fires between 2002 and 2008 that are not covered by USFS burn severity identified in step 1. Combine these data with the results from step 1 to complete the fire severity portion of this ranking
3) Calculate the most recent year a given area burned between 2002 and 2008. Rank fire age based on the following logic:

# of years since burned Rank
1 = 1 (High)
2-3 = 2 (Medium)
4-7 = 3 (Low)

4) Overlay fire severity ranks with fire age ranks and use a balanced 3x3 matrix to rank areas based on these two factors as follows.

		Severity rank 1	2	3	
a	1	1	1	2	
g	2	1	2	3	Stand-level damage
e	3	2	3	3	

Threat: Landscape-Level Wildfire Damage

Landscape-level wildfire damage is designed to describe the fraction of the ecosystem that has been damaged. Rank values for landscape damage are based on the following residual proportions of damaged ecosystems:

>0 and < 19% = 1
19 - 40% = 2
>40% = 3

Priority Landscapes (PL)

Final priority landscape is derived according to the following rule logic based on the combination of stand- and landscape- level damage values:

		STAND DAMAGE 0	1	2	3	
	0	0	--	--	--	
	1	0	1	2	3	
LANDSCAPE DAMAGE	2	0	2	3	3	PL RANK
	3	0	2	3	3	

Thus, effective PL is simply stand damage augmented for ecosystems that have landscape level values of 2 and 3.

Data Used in the Analysis

The datasets used in this analysis are available at http://frap.fire.ca.gov/assessment2010/2.1_fire_threat.html. These are provided to document the analysis, and to provide the potential to replicate results. Updated versions may be available from the various data providers.

ANALYSIS: Restoring Wildfire-Impacted Areas to Maintain Ecosystem Health			
Data theme		**Dataset name**	**Purpose**
THREATS			
THREAT1: Stand-level Wildfire Damage		thr_wfireSTdmg09_1.gdb	Ranks burned areas based on how recently the fire occurred and burn severity.
Inputs	Fire perimeters	input_firep08_2.gdb	Input data used to define burned areas and years since burned
	Burn Severity	VegBurnSeverity08_1.mdb	Input data from US Forest Service used to estimate burn severity by comparing pre- and post-burn Landsat imagery.
	Fuel Rank	Input_frnk02_2	Input data used to estimate burn severity based on fuel conditions, used only for fires where actual burn severity data is lacking
THREAT2: Landscape-level Wildfire Damage		thr_wfireLSdmg09_1.gdb	Ranks areas based on percent of ecosystem that has been damaged by past wildfires
Inputs	Stand-level wildfire damage	thr_wfireSTdmg09_1.gdb	Used to determine the percent of each ecosystem that has been damaged.
ASSETS			
ASSET1: Ecosystems		ast_ecosystems09_1.gdb	Ecosystems defined by each tree seed zone/vegetation (WHR) type combination
Inputs	Tree Seed Zones	input_seedzones02_1.gdb	Tree seed zones used to define ecosystems
	Vegetation	input_fveg06_2.gdb	Vegetation (WHR) types used to define ecosystems
PRIORITY LANDSCAPE			
PL: Restoring Wildfire-Impacted Areas to Maintain Ecosystem Health		pl_t21_a209_2.gdb	Priority landscape for restoring wildfire-impacted areas to maintain ecosystem health
OTHER DATA			
Bioregions		INACCBioreg04_1.gdb	Reporting unit for summarizing results
Counties		cty24k09_1.gdb	Reporting unit for summarizing results
Ownership		owner9group09_1.gdb	Used to report results by major ownership group
HUC8 Watersheds		wbd09_1.gdb	Reporting unit for summarizing results

Analysis #3: Preventing Wildfire Threats for Community Safety

Figure 4: Analytical Framework 3

Asset: Structures

The structures asset identifies concentrations of human settlement and also serves as a proxy for additional human infrastructure that is at risk to damage from wildfires. Data for this asset are derived from migrated census 2000 block data. Ranks for this asset are based on housing unit density;

Housing Density	Asset Rank
>1 HU/acre	3
1HU/ac – 1HU/5 ac	2
1 HU/5ac – 1HU/40 ac	1
<1HU/40 ac	0

These ranks were then modified by overlaying the High Intensity Land Use class from the USGS's National Land Cover Dataset (NLCD landcover class 24) and recoding those areas as rank 3. This modification captures commercial and high density residential areas missed in the census data

Assets: Major Roads, and Transmission Lines

Power transmission lines (from California Energy Commission) and major roadways (from US Census rdtig_hw04_1 Tiger files) were characterized by creating a 150 foot buffer from the linear features, and then gridding at a 30m cell resolution, resulting in a nominal width of 3 cells. All cells tagged as either roads or powerlines were assigned an asset rank of 3, those that had both features were assigned a value of 6.

Community Safety Composite Asset

Composite asset rank was built by summing the housing asset weighted by a factor of three with the road/powerline asset, and then reclassified into High Medium and Low, based on the following matrix

Composite Score	Composite Rank
0	0
1-3	1
4-6	2
7-15	3

Threat: Community Wildfire Threat

The threat data used in this analysis is a new and unique spatial dataset, Fire Hazard Severity Zones (FHSZ), which was built explicitly for adopting new ignition-resistant building code standards, adopted by the California Building Commission in 2007. It is constructed to describe the nature and probability of fire exposure to structures, including those lands that are highly urbanized, but in close proximity to open wildlands. Consequently FHSZ addresses threats in areas where other wildland-fuel based approaches cannot be applied. Details of the FHSZ mapping project are available at http://frap.fire.ca.gov/projects/hazard/fhz.html.

The implementation of final FHSZ maps are jurisdiction specific, and have unique specifications, thus various components were brought together into a single FHSZ threat dataset for use in this analysis. This included State Responsibility Area final adopted data, draft data on federal lands used to map areas required under statute due to proximate effects, and Very High FHSZ lands in Local Responsibility Areas statutorily required under Government Code authority. The latter set of data is in its final stages of completion, with all but five counties finalized for recommendation from CAL FIRE. Areas in the remaining five counties have been based on the original draft data, and will be updated upon finalization. The areas currently reflecting draft FHSZ include Los Angeles, Orange, Mono, Riverside, and Ventura counties. Threat for these counties will be reassessed upon finalization of FHSZ data by March 2010.

Threat ranks are analogous to FHSZ class (i.e, 1 = 1; 2 = 2; and 3 = 3) but as stated above, since only Very High zones were systematically reviewed and validated due to statutory requirements for LRA, only the Very High areas were extracted from the data for use in this analysis.

Priority Landscapes (PL)

Final priority landscapes are determined based on the overlay of composite assets with community wildfire threat, where a priority landscape score is created by summing assets and threats. Final PL ranks are based on the following relationship:

Score	Rank
0	null*
1	null*
2	1
3	1
4	2
5	3
6	3

*The objective of this analysis is to determine areas of community asset value coincident with significant wildland fire threats. Areas with either no asset values or no threat to communities result in a null classification. That is, without *both* measurable assets and threats (according to the model definitions), there is no resultant risk, hence no value in the priority landscape schema.

Data Used in the Analysis

The datasets used in this analysis are available at http://frap.fire.ca.gov/assessment2010/2.1_fire_threat.html. These are provided to document the analysis, and to provide the potential to replicate results. Updated versions of these datasets may be available from the various data providers.

ANALYSIS: Preventing Wildfire Threats for Community Safety			
Data theme		**Dataset name**	**Purpose**
THREATS			
THREAT1: Community Wildfire Threat		thr_wfireSTcomrisk09_3.gdb	Ranks based on the nature and probability of fire exposure to structures, derived from Fire Hazard Severity Zones (FHSZ) data
Inputs	Adopted Fire Hazard Severity Zones (FHSZ) in State Responsibility Areas (SRA)	input_fhsz06.gdb (feature class fhszs06_3)	Input data that defines FHSZ ranks on lands protected by CAL FIRE (SRA)
Inputs	Recommended Very High Fire Hazard Severity Zones (FHSZ) in Local Responsibility Areas (LRA)	input_fhsz06.gdb (feature class fhszl06_3_recommended)	Input data that defines FHSZ ranks on lands protected by local government (LRA)
ASSETS			
ASSET1: Structures		ast_structures09_2.gdb	Ranks based on housing density, derived from 2000 census block data
Inputs	Housing density	cen00blm03_1.gdb	Housing density from 2000 Census, migrated to remove population from federal lands
Inputs	Commercial areas (NLCD)	input_NLCD24commercial09_1.gdb	Commercial development
ASSET2: Major Roads		ast_roads09_1.gdb	Major roads buffered and ranked high, derived from US Census TIGER data
Inputs	Major roads	rdtig_hw04_1.gdb	US Census Bureau Tiger road data used to extract major roads
ASSET3: Transmission Lines		ast_powerlines09_2.gdb	Transmission lines buffered and ranked high, derived from California Energy Commission
Inputs	Transmission Lines	input_ptline03_2.gdb	Transmission lines data from California Energy Commission
PRIORITY LANDSCAPE			
PL: Preventing Wildfire Threats for Community Safety		pl_t21_a109_2.gdb	Priority landscape for preventing wildfire threats for community safety
OTHER DATA			
Bioregions		INACCBioreg04_1.gdb	Reporting unit for summarizing results

Comm unities		community09_3.gdb	Reporting unit for summarizing results

Data and Analysis Limitations

Data Element	Date	Source	Purpose	Currency	Completeness	Detail	Consistency	Relevance	Limitations
Vegetation (v06_2)	2006	CAL FIRE - FRAP	V06_2 (and 02_2) were inputs for fire threat, condition class, ecosystems	F	G	G	F	G	Data is outdated, inconsistent, and does not reflect timber harvest activity.
Fire Threat	2003	CAL FIRE - FRAP	Input for stand-level wildfire threat	F	G	G	F	F	Data is based on outdated, inconsistent vegetation data.
Fire perimeters	2009	CAL FIRE-FRAP	Past burns for stand- and landscape-level damage	E	G	G	G	E	Compiled from various fire service providers, quality varies
Burn severity	2009	USFS	Input to stand-level wildfire damage	G	G	G	G	E	Severity missing for some past fires
Condition class	2003	CAL FIRE-FRAP	Input to landscape-level wildfire threat	F	G	G	F	E	Data is based on outdated, inconsistent vegetation and fire data.
Adopted FHSZ (SRA)	2006	CAL FIRE-FRAP	Input for community wildfire threat	G	G	F	G	E	
Recommended FHSZ (LRA)	2006	CAL FIRE-FRAP	Input for community wildfire threat	G	F	G	G	E	May not be the same as actual local ordinances implemented. Also, several counties are still in draft form.
Tree Seed Zones	2002	CAL FIRE	Ecosystem Asset	F	G	F	E	E	The 1,000-foot criteria adopted as USDA forest seed policy was not used for this analysis. Ecosystems were allowed to cross these elevations in a single seed zone.
Major Roads	2004	USGS	Identify Major Road assets at risk (150 buffer around roads)	F	G	F	E	E	Only major roads used. Road locations are somewhat generalized. 150 foot buffer is an approximation of the zone at risk.
Major Power lines	2004	CEC	Identify major power line assets at risk	F	F	P	P	G	Only major transmission lines identified. Locations approximate.
Census 2000 – Migrated	2004	US Census/CAL	Identify Structure assets at risk	P	G	F	E	E	Census data is almost 10 years old. Data migrated off of Federal

		FIRE FRAP							lands where few people live.