Forest Pests and Other Threats to Ecosystem Health

Methodology

Four unique FRAP analyses were conducted to address forest pest impacts in California. Two of these analyses address ecosystem health and two analyses address public safety at the community level.

Analyses – Restore Forest Pest Impacted Areas

1. Restore impacted areas, to maintain ecosystem health and restore important ecosystem services and public benefits.
2. Restore forest pest impacted areas near communities with the most severe hazards from falling trees to maintain public safety.

Analyses – Prevent Future Forest Pest Outbreaks

3. Prevent outbreaks, especially those with the potential to cause widespread damage to entire ecosystems, to maintain ecosystem health and to preserve important ecosystem services and public benefits.
4. Prevent outbreaks in communities where they are most likely and would cause the most severe public safety risks from falling trees.

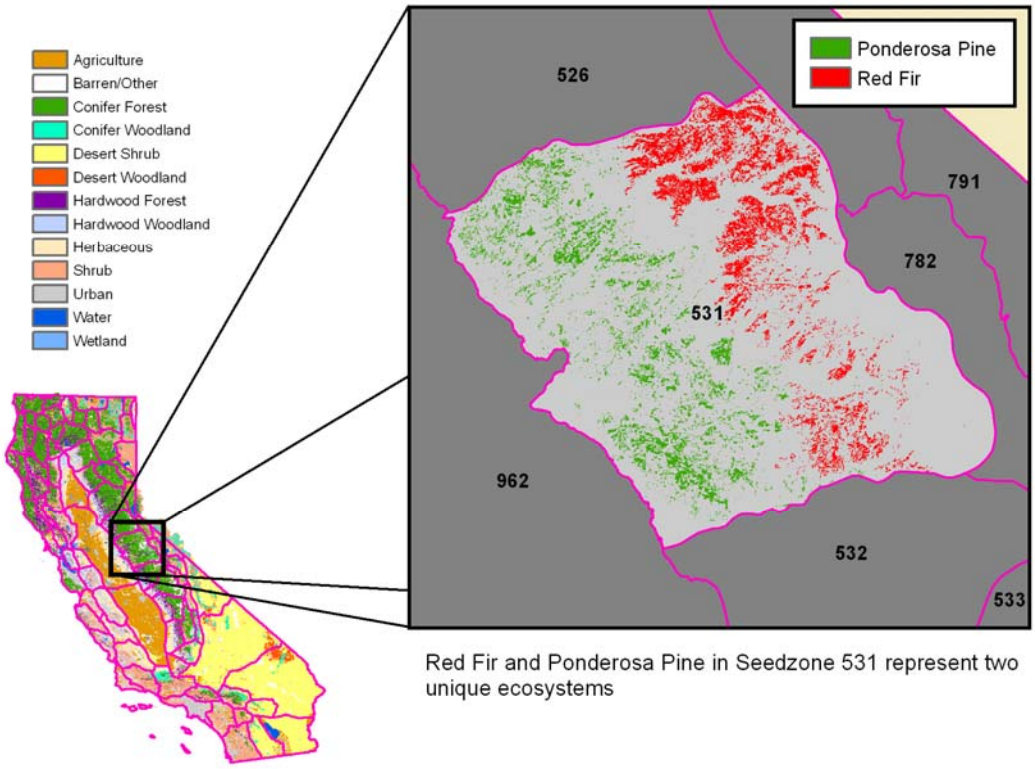
Key Concepts:

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

Ecosystems

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

Figure 1: Land Cover and Seed zones in California

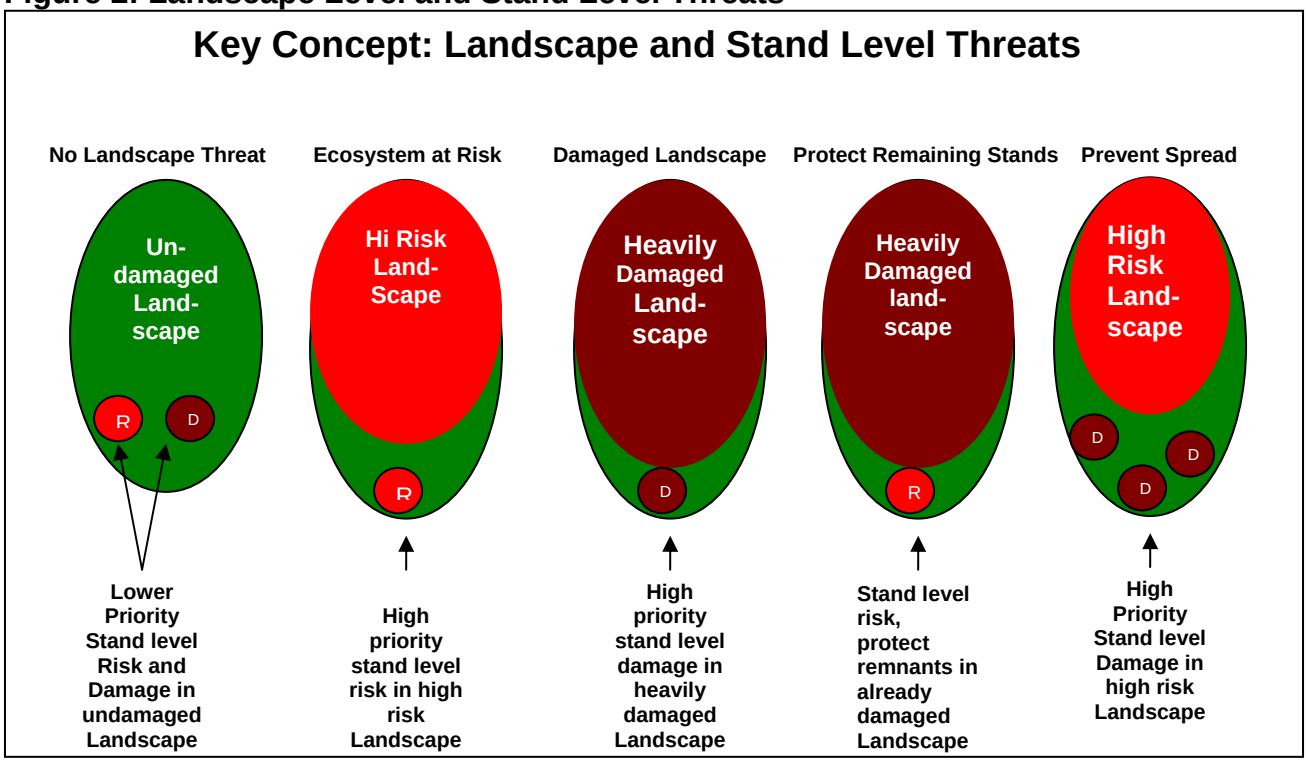


Red Fir and Ponderosa Pine in Seedzone 531 represent two unique ecosystems

Landscape Level Damages and Threats:

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 (see figure 2). While stand-level impacts can result in loss of timber volume or wildlife habitat, 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. Higher priority is given to damages or risks in ecosystems that have been heavily damaged, or have high risk of future damage.

Figure 2: Landscape Level and Stand Level Threats

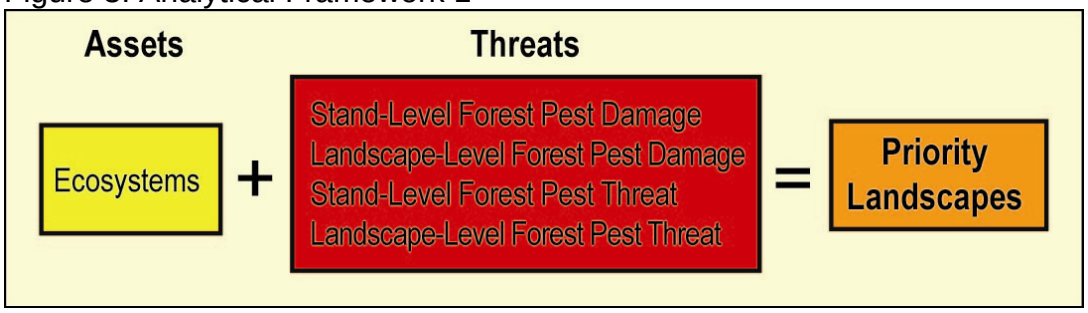


Communities

The community concept is used in the second analysis as a reporting unit for assessing impact of current forest pest outbreaks to human infrastructure. In the fourth analysis, communities are also used to represent the concentration of people and the human infrastructure needed to support them.

Analysis #1: Restoring Forest Pest-Impacted Areas to Maintain Ecosystem Health

Figure 3: Analytical Framework 1



Threat: Stand-Level Forest Pest Damage

Threat data developed for this analysis measures the actual stand level damage (tree mortality) from 1994-2008 using three measures provided by the aerial detection survey (ADS) data from the USDA Forest Service, Forest Health Protection (FHP) staff (http://www.fs.fed.us/r5/spf/fhp/fhm/aerial/index.shtml). The three measures used to rank the stand level damage in this analysis are severity, damage causing agent, and age.

Severity:

CAL FIRE – FRAP analyzed insect and disease related tree mortality data from aerial detection surveys (ADS) conducted from 1999 – 2008 to determine the severity of the stand level damage a given area experienced. The years 1994 – 1998 were omitted due to data limitations. CAL Fire looked at the estimated number of trees per acre for each damage causing agent and report year (TPA1, TPA2 and TPA3 attributes) to determine the severity of each mortality event in a given year. Initially, the ADS data were filtered to identify only damage agents related to forest pests or drought, and removing fire, herbicides and other non-insect related causes of mortality. Next, TPA1, TPA2, and TPA3 were added together for each year and then all years were added together to identify areas with the most severe tree mortality over the last 10 years.

Damage Causing Agents:

The second measure of stand level damage is based on the damage causing agent (DCA). Some forest pests are considered more of a threat (eg. Bark beetles as opposed to a spruce bud worm) or damaging than others. Using the ADS data, damage causing agents were ranked into low, medium and high categories based upon 1)the historical number of acres of tree mortality caused by that agent in California and; 2) expert opinion provided by the FHP aerial detection survey program manager, Zack Heath.

In general DCA's that caused less than 10,000 acres of tree mortality over the last 15 years were ranked low, DCA's that caused between 10,000 and 100,000

acres of tree mortality over the last 15 years were ranked medium and DCA's that caused greater than 100,000 acres of tree mortality over the last 15 years were ranked high. These were then modified based on expert knowledge of the ADS data set. Expert knowledge of the data is critical, since the cause of some outbreaks may take several years to identify, and as such are often mapped as 'unknown' in earlier years.

Table 1: Damage Causing Agent Ranks

COMMON_NAM	RANK_DCA1
Fire	0
wild fire	0
human caused fire	0
Wild Animals	0
Bear	0
flooding/high water	0
Frost	0
snow/ice	0
wind-tornado	0
Avalanche	0
mud-land slide	0
Volcano	0
Human Activities	0
Herbicides	0
land use conversion	0
Mechanical	0
Suppression	0
General Insects	1
California fivespined ips	1
Ips engraver beetles	1
cedar bark beetles	1
true fir bark beetles	1
Defoliators	1
alder flea beetle	1
fruit tree leafroller	1
Modoc budworm	1
Leafhopper	1
birch casebearer	1
California oakworm	1
pine needle sheathminer	1
California flathead borer	1
General Diseases	1
black stain root disease	1
Port-Orford-Cedar root disease	1
aspen trunk rot	1
western dwarf mistletoe	1
red fir dwarf mistletoe	1
Decline Complexes/Dieback/Wilts	1
Complex	1
true fir pest complex	1
Foliage diseases	1
Needlecast	1
sycamore anthracnose	1

Dothistroma needle blight	1
Diplodia blight	1
white pine blister rust	1
dead top	1
foliage discoloration	1
Mortality	1
No Data	1
western pine beetle	2
Jeffery pine beetle	2
pinon ips	2
Douglas-fir tussock moth	2
sudden oak death	2
Cytospora canker of fir	2
Drought	2
Unknown	3
Bark Beetles	3
mountain pine beetle	3
fir engraver	3
lodgepole needleminer	3
fall webworm	3
Unknown	3
Multi-Damage (Insect/Disease)	3
Unknown	3

Age:

The third measure of stand-level damage is based on when the insect or disease outbreak was last observed, with the more recent years receiving a higher priority than older outbreaks. Specifically, years 1-2 are ranked high, years 3-5 are ranked moderate and outbreaks 5-15 years old are ranked low. Spatial data on outbreaks older than 15 years were not readily available.

Table 2: Age Ranking

Year of outbreak	**Age rank**
< 2004	L
2004-2006	M
2007-2008	H

Stand-Level Damage

Each component is overlaid then given equal weighting in this analysis to develop the final stand-level damage ranks. A total score attribute is calculated by adding up the 0-3 ranks for each component (age, cause and severity). An ordinal weighting is used to arrive at final ranks (Table 1).

Table 3: Composite Stand-Level Ranking

Total Score	Rank_InsctDmg
0	0
1-3	1
4-6	2
7-9	3

Threat: Landscape-Level Forest Pest Damage:

This threat layer measures landscape level damage to ecosystems based upon past forest pest outbreaks (see key concepts for a description of ecosystems). The stand-level damage dataset (thr_insctStdmg09_2) is used to identify impacted ecosystems. For each ecosystem, we calculate the percent of the acreage that needs restoration based upon the percentage of the ecosystem that has high stand-level damages. Ecosystems are then ranked based on percentage of total ecosystem acreage that needs restoration, e.g. H = > 30%, M = 10-30%, L = 0 - 10%. Ecosystems without any high ranked stand level damages received a zero ranking. The following table provides an example;

Table 4: Example of ecosystem restoration ranking method

Ecosystem	% of acres ranked with high damages	Ecosystem Damage Rank
Ponderosa Pine/Zone 1 (north sierra)	65%	H
Redwood/Zone 6 (north coast)	5%	L
Mixed Conifer/Zone 1 (north sierra)	21%	M
Coast Oak Woodland/Zone 3 (central coast)	29%	M

Threat: Stand-Level Forest Pest Threat

Stand-level threats are ranked based on expected tree loss. The insect and disease risk map used here was generated by the USDA Forest Service Forest Health Protection program (FHP) http://www.fs.fed.us/r5/spf/fhp/fhm/risk/index.shtml. These data were then divided into 4 categories of risk by the CAL FIRE – FRAP. Forest areas considered to be at risk are those that are designated by this data layer as having the potential for 25 percent or more volume loss due to forest pests over the next 15 years, including background mortality..

Table 5: Stand-Level Threat Ranking

Expected tree loss in 15 years	Rank
<25%	-
25-50%	L
50-75%	M
> 75%	H

Threat: Landscape-Level Forest Pest 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 medium or high stand-level threat (above). For example, ecosystems expected to have tree loss over 50% by 2020. Ecosystems are then ranked based on percentage of total ecosystem acreage that is unhealthy, e.g. H = > 50%, M = 10-50%, L = < 10%.

Detailed Steps to create the Landscape-level threat layer:

- Select the "Medium" (50-75% expected mortality) and "High" (greater than 75% expected mortality) mortality categories from the Stand-Level Insect / Disease Threat.
- Overlay the results of step 1 with Tree Seed Zones and the forest type map.
- Calculate the percent of each forest type and seed zone that has greater than 50% expected stand level mortality caused by insects or diseases.
- Rank Landscape level threat based upon the percent of each forest type in a seed zone that is expected to have an elevated (greater than 50%) stand level mortality
    - Rank 0: No stand level insect and disease threats above 50% (medium and high stand level threats
    - Rank 1 (low): Greater than zero, and Less than 10% of the forest type and seed zone has a stand level threat of medium or high insect and disease mortality.
    - Rank 2 (medium): Between 10% and 50% of the forest type and seed zone has a stand level threat of medium (50-75%) or high (>75%).
    - Rank 3 (high): Greater than 50% of the forest type and seed zone has a stand level threat of medium (50-75%) and/or high (>75%) expected stand-level mortality

Priority Landscapes (PL)

The overlay of threats (stand-level damage, landscape-level damage, stand-level risk and landscape-level risk) produces the priority landscape for restoring ecosystem health after forest pest damages have occurred.

PL Ranking

Pre-ranking logic:

Assign 'pre-rank' based on following matrix (figure 4), which uses stand-level damage and landscape-level damage to get to an initial pre-ranked priority landscape. These ranks become the default priority landscape rank, but can be replaced for 1 special case.

Figure 4: Pre-ranking logic for priority landscape to restore ecosystems:

Landscape Damage Rank	Stand Damage Rank 0	1	2	3
0	0	1	1	1
1	0	1	1	2
2	0	1	2	3
3	0	2	3	3

Priority Landscape Rank

1 = low rank
2 = medium rank
3 = high rank

Final Ranking Logic:
Final ranks are based on the assigned pre-rank, except in two special cases,

Special case #1: the damaged portion of an undamaged ecosystem with a significant landscape-level risk (in short, contain the outbreak before it spreads into ecosystems most at risk).

This special case area is identified by;
- Damaged areas have stand-level damage = 1, 2, or 3
- Undamaged ecosystems have landscape-level damage = 0 or 1
- High landscape threat have landscape-level threat 2 or 3

Any cell that meets these criteria is considered to be the damaged portion of an undamaged ecosystem high landscape risk .

For these special cases areas, we set the priority landscape rank to the stand-level damage rank plus one, maximum resulting rank of 3 (ignore pre-rank).

Data Used in the Analysis

The datasets used in this analysis are available at http://frap.fire.ca.gov/assessment2010/2.2_forest_health.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: Restoring Forest Pest-Impact Areas to Maintain Ecosystem Health			
Data theme		**Dataset name**	**Purpose**
THREATS			
THREAT1: Stand-Level Forest Pest Damage		thr_insctSTdmg09_2.gdb	Ranks areas based on severity of tree mortality, damage causing agent, and how recently the outbreak occurred.
Inputs	Current mortality from forest insects and disease	ADS_all_yrs_Regionwide.mdb	Tree mortality data from aerial detection surveys including trees per acre, damage causing agent, tree species, etc. Surveys performed by US Forest Service and National Park Service.
THREAT2: Stand-Level Forest Pest Threat		thr_insctSTrisk09_1.gdb	Ranks areas based on expected loss of tree volume over the next 15 years
Inputs	Forest Pest Risk, USFS FHP (2006 v1)	insctRisk09_1.gdb	Input dataset used to develop forest pest rank based on expected future tree mortality
THREAT3: Landscape-Level Forest Pest Damage		thr_insctLSdmg09_2.gdb	Ranks all areas in an ecosystem based on percent of the ecosystem with high stand-level damage
Inputs	Stand-Level Forest Pest Damage	thr_insctSTdmg09_2.gdb	Ranks areas based on severity of tree mortality, damage causing agent, and how recently the outbreak occurred.
THREAT4: Landscape-Level Forest Pest Threat		thr_insctLSrisk09_1.gdb	Ranks all areas in an ecosystem based on percent of the ecosystem with high or medium stand-level threat
Inputs	Stand-Level Forest Pest Threat	thr_insctSTrisk09_1.gdb	Ranks areas based on expected loss of tree volume over the next 15 years
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 Forest Pest-Impacted Areas to Maintain Ecosystem Health	pl_t22a209_2.gdb	Priority landscape for restoring forest pest-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

Analysis #2: Restoring Forest Pest-Impacted Communities for Public Safety

Figure 5. Analytical framework 2

This analysis identifies priority landscapes in communities already impacted by forest pest outbreaks, and that are most likely to have associated risks to public safety and human infrastructure. Here, we analyze information on current stand-level mortality from the last 15 years to measure the degree of impact from past or current forest pest outbreaks. In this analysis we prioritize areas to restore based on human infrastructure factors, such as houses, transmission lines and roads.

Assets:

Structures

This asset identifies concentrations of human settlement and commercial development and also serves as a proxy for additional human infrastructure that is at risk from falling trees such as minor roads, distribution lines, etc.

Major Roads and Transmission lines

In communities impacted by forest pest outbreaks, dead trees with the potential for falling along major thoroughfares become a high priority for treatment. A 150 foot buffer around major transportation routes is used to delineate areas that will be assigned a high rank. Identical to roads, a 150 buffer is ranked high around major transmission lines.

Composite Assets

High priority is given to dense housing and Moderate ranking is given to major roads and transmission lines. When generating the composite asset, housing is weighted 3 times as much as transmission lines and roads.

Threat: Stand-Level Forest Pest Damage

This threat layer is the same as presented in the previous analysis.

Priority Landscapes

The overlay of the –level damage (thr_insctSTdmg) and the composite asset layer (astc_t22A309_2) produces Priority Landscapes. The priority landscapes here refer to actual infested areas near communities that may need protection from falling trees and fire.

Ranking logic:
Assign a priority rank based on following matrix (figure 6), which uses stand-level damage and composite assets to get to ranked priority landscape.

Figure 6: Pre-ranking logic for

		Insct Threat rank			
a		1	2	3	
s	R				
s	a 1	1	1	2	
e	n 2	1	2	3	Threat
t	k 3	2	3	3	

1 = Low
2 = Medium
3 = High

Data Used in the Analysis

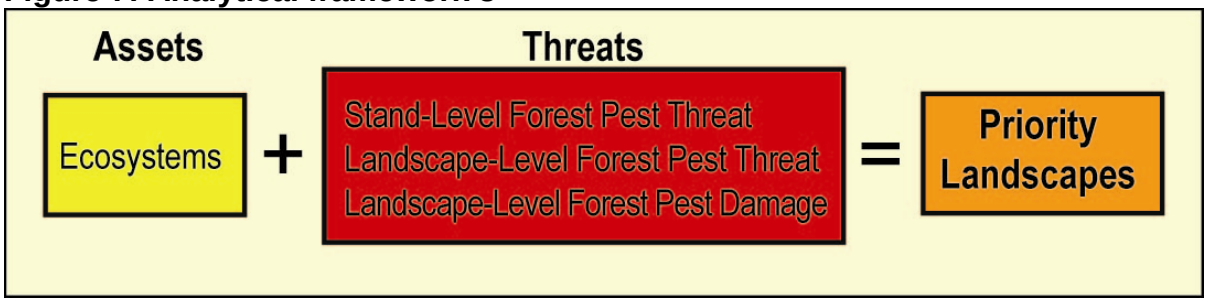
The datasets used in this analysis are available at http://frap.fire.ca.gov/assessment2010/2.2_forest_health.html. These are provided to document the analysis, and to provide the potential to replicate results. Updated versions of these datasets may be available from the various data providers.

ANALYSIS: Restoring Forest Pest-Impacted Communities for Public Safety			
Data theme		**Dataset name**	**Purpose**
THREATS			
THREAT1: Stand-Level Forest Pest Damage		thr_insctSTdmg09_2.gdb	Ranks areas based on severity of tree mortality, damage causing agent, and how recently the outbreak occurred.
Inputs	Current mortality from forest insects and disease	ADS_all_yrs_Regionwide.mdb	Tree mortality data from aerial detection surveys including trees per acre, damage causing agent, tree species, etc. Surveys performed by US Forest Service and National Park Service.
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
	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: Restoring Forest Pest-Impacted Communities for Public Safety		pl_t22a409_1.gdb	Priority landscape for restoring forest pest-impacted communities for public safety
OTHER DATA			
Bioregions		INACCBioreg04_1.gdb	Reporting unit for summarizing results
Communities		community09_3.gdb	Reporting unit for summarizing results

Analysis #3: Preventing Forest Pest Outbreaks to Maintain Ecosystem Health

Figure 7: Analytical framework 3



Threat: Stand-Level Risk
This analysis uses the same stand-level threat data as was presented in analysis #1.

Threat: Landscape-Level Forest Pest Risk to Ecosystems
This analysis uses the same landscape-level threat data as was presented in analysis #1.

Threat: Landscape Level Damage:
This analysis uses the same landscape-level damage data as was presented in analysis #1

Priority Landscapes (PL)

The overlay of threats (stand-level damage, landscape-level damage, stand-level risk and landscape-level risk) produces Priority Landscape for restoring ecosystem health after forest pest damages have occurred.

PL Ranking

Pre-ranking logic:

Assign ‘pre-rank’ based on following matrix (figure 8), which uses stand-level damage and landscape-level damage to get to an initial pre-ranked priority landscape. These ranks become the default priority landscape rank, but can be replaced for 2 special cases.

Figure 8: Pre-ranking logic for priority landscape:

Landscp Threat Rank	Stand Threat rank 0	1	2	3
0	0	1	1	1
1	0	1	1	2
2	0	1	2	3
3	0	2	3	3

Priority Landscape Rank

1 = low rank
2 = medium rank
3 = high rank

Final Ranking Logic:

Final ranks are based on the assigned pre-rank, except in two special cases,

Special case # 1: Protect the undamaged portion of heavily damaged ecosystems.

These special case areas are identified by:

- Undamaged areas are identified by stand level damage = 0 or 1
- Damaged ecosystems are identified by landscape level damage = 2 or 3

Any cell that meets these criteria is considered to be the undamaged portion of a damaged ecosystem. For these special cases areas, if the stand-level threat is non-zero, make the PL rank equal to the stand-level threat plus 1 (ignore pre-rank).

Special case #2: Areas that already have significant damage, which should be targeted for restoration rather than protection. These are identified by stand-level

damage = 2 or 3, and they get assigned a zero for the risk reduction priority landscape.

Data Used in the Analysis

The datasets used in this analysis are available at http://frap.fire.ca.gov/assessment2010/2.2_forest_health.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 Forest Pest Outbreaks to Maintain Ecosystem Health			
	Data theme	**Dataset name**	**Purpose**
THREATS			
THREAT1: Stand-Level Forest Pest Threat		thr_insctSTrisk09_1.gdb	Ranks areas based on expected loss of tree volume over the next 15 years
Inputs	Forest Pest Risk, USFS FHP (2006 v1)	insctRisk09_1.gdb	Input dataset used to develop forest pest rank based on expected future tree mortality
THREAT2: Landscape-Level Forest Pest Damage		thr_insctLSdmg09_2.gdb	Ranks all areas in an ecosystem based on percent of the ecosystem with high stand-level damage
Inputs	Stand-Level Forest Pest Damage	thr_insctSTdmg09_2.gdb	Ranks areas based on severity of tree mortality, damage causing agent, and how recently the outbreak occurred.
THREAT3: Landscape-Level Forest Pest Threat		thr_insctLSrisk09_1.gdb	Ranks all areas in an ecosystem based on percent of the ecosystem with high or medium stand-level threat
Inputs	Stand-Level Forest Pest Threat	thr_insctSTrisk09_1.gdb	Ranks areas based on expected loss of tree volume over the next 15 years
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 Forest Pest Outbreaks to Maintain Ecosystem Health		pl_t22a109_2.gdb	Priority landscape for Preventing Forest Pest Outbreaks 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

Analysis #4: Preventing Forest Pest Outbreaks for Community Safety

This analysis examines the convergence of areas with high forest pest risk and human infrastructure assets.

Figure 9. Analytical framework 4

Asset: Communities

The FRAP community data layer identifies incorporated cities and other census defined places where people live and is used in this analysis to represent the concentration of people and the human infrastructure needed to support these communities.

Threat: Stand-Level Forest Pest Threat

This analysis uses the same stand-level threat data as was presented in analysis #1.

Priority Landscape

The overlay of the stand-level threat (thr_insctSTrisk09_1) and the community asset layer produces Priority Landscapes. Final priority ranks are based upon the stand-level risk identified in each community. Only communities with stand level insect threats mapped inside the community are considered here. It is important to note that priority landscapes, in this case, do not necessarily equate to acres potentially in need of treatment. Often larger areas, away from community assets

may require treatment to prevent outbreaks that could spread and place dead trees in striking distance of community assets.

Data Used in the Analysis

The datasets used in this analysis are available at http://frap.fire.ca.gov/assessment2010/2.2_forest_health.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 Forest Pest Outbreaks for Community Safety			
	Data theme	**Dataset name**	**Purpose**
THREATS			
THREAT1: Stand-Level Forest Pest Threat		thr_insctSTrisk09_1.gdb	Ranks areas based on expected loss of tree volume over the next 15 years
Inputs	Forest Pest Risk, USFS FHP (2006 v1)	insctRisk09_1.gdb	Input dataset used to develop forest pest rank based on expected future tree mortality
ASSETS			
ASSET1: Communities		community09_3.gdb	Community boundaries are used to summarize degree of stand-level threat within each community
Inputs	Incorporated Cities	incorp09_1.gdb	Provides the incorporated city portion of the communities dataset
	Census Designated Places	cen00pl02_1.gdb	Provides the unincorporated places portion of the communities dataset
PRIORITY LANDSCAPE			
PL: Preventing Forest Pest Outbreaks for Community Safety		pl_t22a309_4.gdb	Priority landscape for preventing forest pest outbreaks for community safety
OTHER DATA			
Bioregions		INACCBioreg04_1.gdb	Reporting unit for summarizing results

Data and Analysis Limitations

Data Quality

Data Element[1]	Date	Source	Purpose	Age[2]	Completeness	Detail	Consistency	Relevance	Limitations
Aerial Survey Data	2008	USFS FHP	Current morality from insects/disease	E	G	E	E	E	Polygons are often large and generalized. Severity data was unknown for most polygons in years prior to 1999. Damage causing agents are not always known.
USFS Insect and Disease Risk modeling	2009	USFS FHP	Risk of future insect/disease outbreaks	E	E	G	E	G	Risk of future outbreaks is modeled and has an unknown accuracy. Input data spans multiple years.
Vegetation Data (v06_2)	2006	CAL FIRE - FRAP	Ecosystem Asset	F	G	F	F	G	Source data varies in quality, detail and age.
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.
Community Boundaries	2009	CAL FIRE – FRAP	Community Assets	G	F	G	F	G	Some populated areas are missed due to several possible factors. Area of some communities with low population can be large, although the concentration of assets may be low when compared to more populated communities.
Communities	2009	FRAP (incorporated cities)	Reporting Unit	E	E	E	G	E	
Communities	2009	US Census	Reporting Unit	F	F	P	F	F	Census data sometimes drew huge boundaries around very small communities, and omitted small population centers that should have been included as communities
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 FIRE FRAP	Identify Structure assets at risk	P	G	F	E	E	Census data is almost 10 years old. Data migrated off of Federal lands where few people live.
Missing Data Element			**Purpose**						
Invasive Plant Species			Impacted areas for restoration						

1. Other data required as inputs to create the above data or as a reporting metric: land ownership
2. P = Poor F = Fair G = Good E = Excellent

Appropriate Use and Limitations

These analyses are designed to quantify the relative amount of priority areas over larger reporting units (communities, counties, bioregions), not identify specific areas for treatment.

Data gaps and data improvements

Due to the lack of comprehensive and consistent, statewide data on air pollution threats and invasive plant species locations, these sections are handled only by narrative.

The lack of information on forest vegetation in the urban environment made analysis of threats to human infrastructure less complete. Other suggested improvements in vegetation data include regular updating of existing vegetation maps and inventories to reflect more current conditions, regular, systematic and consistent monitoring of changes in vegetation composition and structure, and development of information on urban trees and other urban vegetation. Also, The State should consider an alternative way to designate and map unincorporated communities, and to maintain boundaries for these areas more frequently than once a decade.

Things that could not be analyzed:
One of four spatial analyses presented in this chapter addresses protecting communities from future forest pest outbreaks. It is important to note that for the protecting community analysis, only communities with stand level insect threats mapped inside the community are considered. Often larger areas, away from community assets may require treatment to prevent outbreaks that could spread and place dead trees in striking distance of community assets. Due to data and time limitations this analysis does not consider these proximate threats. An analysis that considers additional *proximate* threats would likely identify more communities in need of protection from future forest pest outbreaks. Regardless, descriptive statistics presented here help prioritize potential investments for forest pest prevention activities that protect communities from future forest pest outbreaks.