

System Indicators

Forest Health and Carbon Storage



Forest Health Indicators Related to Pests (2010)

December 2012

Forest Health Indicators Related to Pests

Like wildfire, insects and diseases are a natural and necessary part of Sierra forest ecosystems. Insects that kill trees also prey on other insects and provide food for wildlife. Tree diseases and rots speed decay of wood back into nutrients for the next generation of trees. Tree mortality from insects and disease (together known as forest pests) is usually localized, affecting only a few trees in a small area. However, epidemic levels of mortality occasionally occur as happened in the large numbers of Southern California trees killed by drought and insects in the late 1990s (Christensen et al., 2008).

Insects typically kill trees that are weakened by other stressors such as lack of moisture, sunlight, nutrients or growing space. Bark beetles gain entry to trees by boring through bark where females lay eggs in tunnels excavated beneath the bark. This disrupts the conductive tissue below the bark and eventually kills the tree once it is girdled. Trees respond to beetle attacks by sending pitch to the entry wounds to try to push the beetles out. Trees that are stressed are less able to respond and so more likely to succumb and die.

Forests typically experience background levels of tree mortality from pests until large scale stressing events such as drought or wildfire weakens large numbers of trees, enabling pests to cause epidemic levels of mortality over large areas. The background rate of tree mortality is generally considered to be about 1% a year (van Mantgem and Stephenson 2007).

However, there is evidence from research in the Sierra and across the West that the background rate of tree mortality has been increasing. One study conducted using a network of old-growth forest plots in the Sierra found that tree mortality due to forest pests and stress increased on average by 3% per year, meaning that the rate nearly doubled between 1983 and 2004, from about 1% a year to about 2% a year (van Mantgem and Stephenson 2007). Researchers found that both pine and fir trees had a similar increase in mortality. They suggested that the primary cause is increased drought stress due to increases in temperature as a result of climate change. Mortality increased regardless of elevation, tree density or competition.

Warming is thought to contribute to increasing mortality by increasing drought stress on trees while at the same time stimulating the growth and reproduction of insects and pathogens that attack trees. Warming is thought to have played a key role in recent large episodes of forest dieback elsewhere in Western North America (van Mantgem et al., 2009). Researchers suggest that Sierra and other water-limited forests “are sensitive to temperature-driven drought stress, and may be poised for die-back if future climates continue to feature rising temperatures without compensating increases in precipitation” (van Mantgem and Stephenson 2007, page 914).

Forest Pest Impact and Threat to Ecosystems

Data from forest pest threats to ecosystems in California has been assembled and published by CALFIRE (CALFIRE 2010). They identified ecosystems where the current impact and future threat from forest pests to ecosystem services is highest and classified them into low, medium,

and high priority landscapes for addressing the threats. CALFIRE found over 6 million acres impacted by forest pests in California. Sierra mixed conifer forests were identified as the most impacted forest type in the state with over 1.7 million acres, or 36% of the forest identified for restoration to mitigate impacts of past damage. In the Sierra Nevada, almost 1.2 million acres were identified as high priority areas for restoring lands impacted by pests (see Figure 15). Seventy-six percent of priority landscapes are on lands managed by the U.S. Forest Service (USFS) and 17 percent are on privately owned lands.

CALFIRE also prioritized the forested areas where action to reduce future forest pest impacts is needed (see Figure 16). Actions could include removal of dead and dying trees near community infrastructure, removal of live vegetation at risk due to being next to dead or dying trees, and removal of soil harboring pathogens. Other actions could include education and outreach to land owners and forestry assistance programs. Over one million acres of Sierra forest not yet significantly impacted by pests are identified for some level of need to prevent future pest infestation, with over 227,000 acres identified as high priority. Of the forest land identified as high priority for preventing pest outbreaks, 75% was USFS and 14% was private (see Figure 14).

Altogether, Forest Service land contains almost 1.1 million acres of high priority areas to treat for pest impacts or pest prevention, over 10% of its ownership. Privately owned land has 236,000 acres of high priority area identified for impact or prevention treatment.

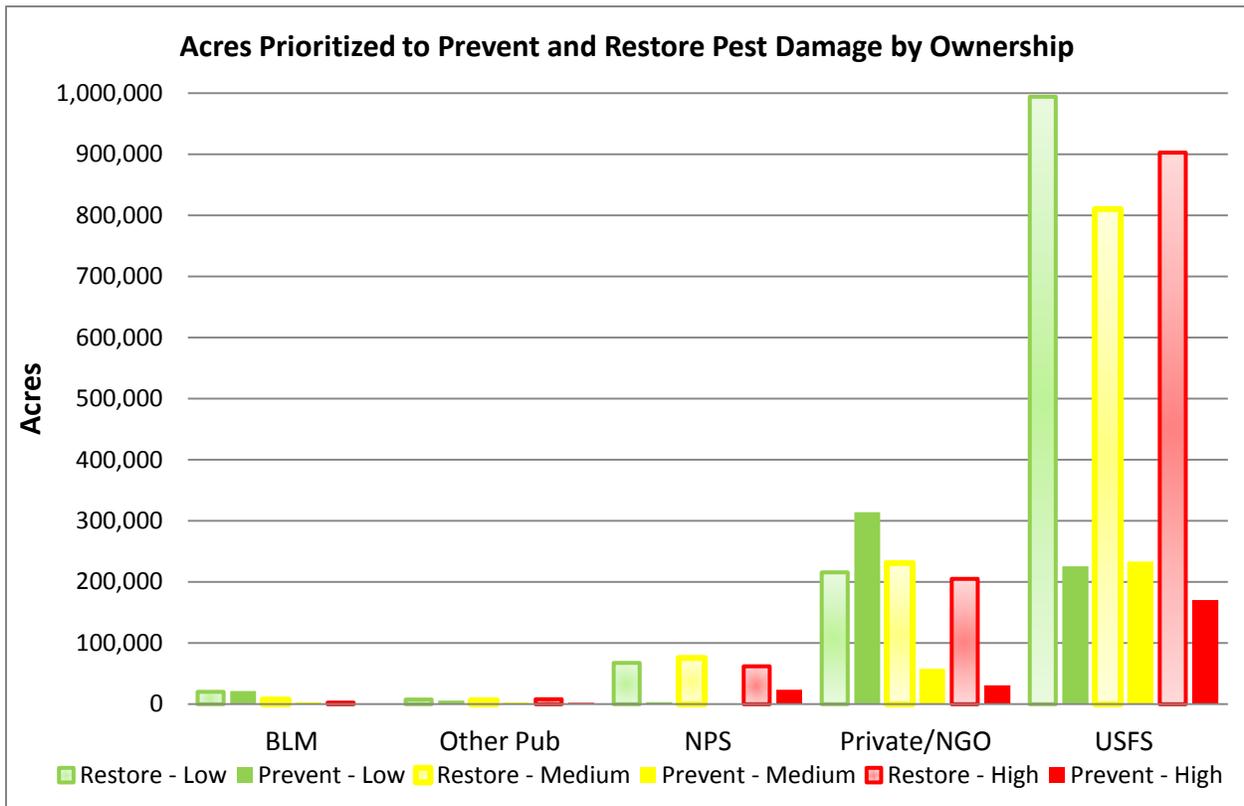


Figure 14. Acres prioritized for prevention and restoration of pest damage by landowner

Figure 15. CAL FIRE Landscape Priority for Restoring Forests from Pest Impacts

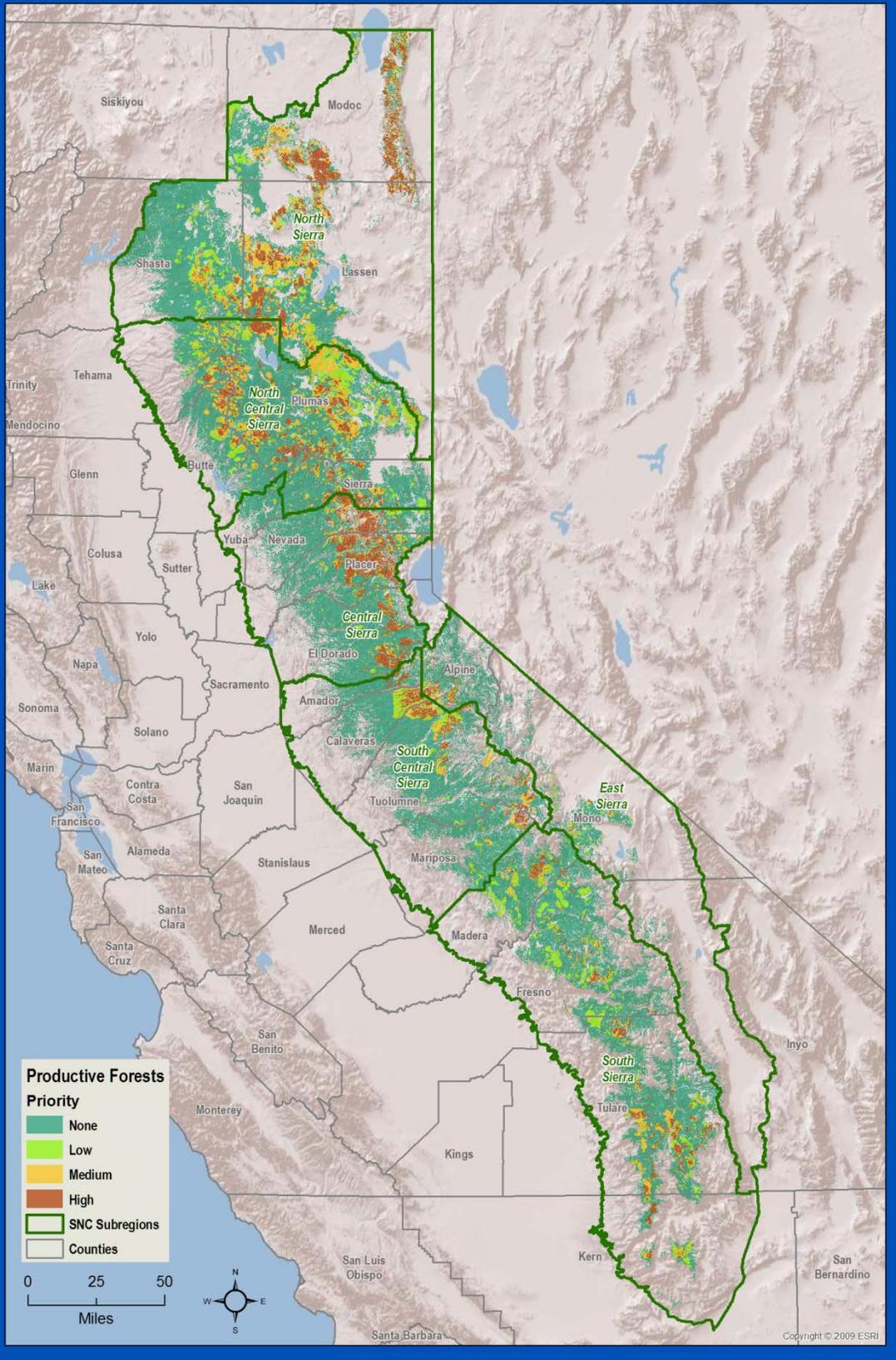
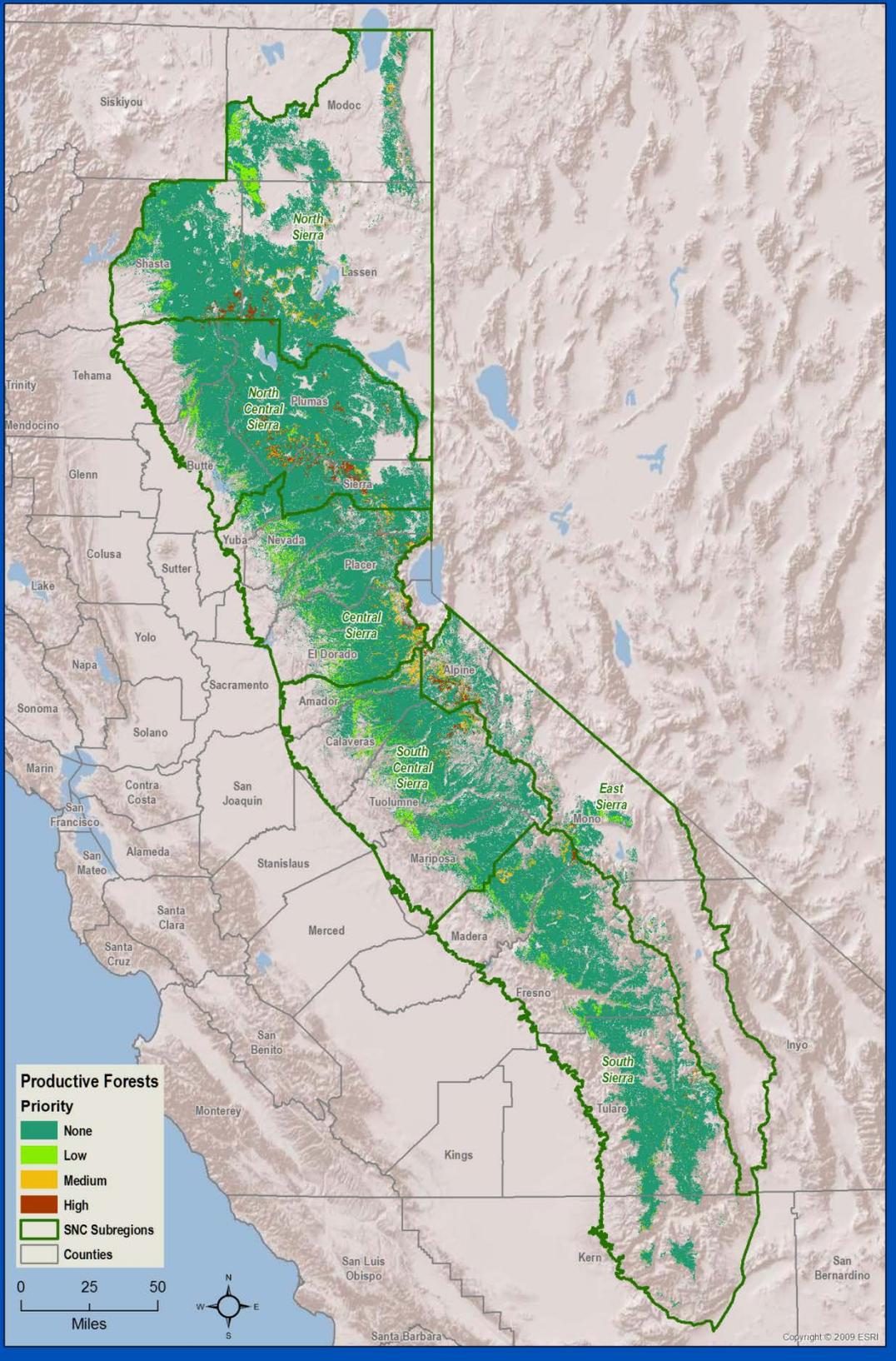


Figure 16. CAL FIRE Landscape Priority for Preventing Future Pest Outbreaks in Forests



Forest Pest Impact and Threat to People

When they cause epidemic levels of mortality, forest pests have a disruptive influence on human communities. Dead and dying trees can fall and block major transportation routes, hit power lines (sometimes starting fires), or crush structures. An estimated 3.5 million trees died due to the combined effects of drought and insects between 1998 and 2003 on forest land in the counties of San Bernardino, Riverside, San Diego, and Los Angeles. The overall mortality rate for conifers over this period was 13% (Christensen et al., 2008). This mass die off spurred coordinated efforts from land management and regulatory agencies to remove over 1.5 million dead trees. This effort cost \$225 million over three years (CALFIRE 2010). CALFIRE has the authority, with the approval of the California Board of Forestry and Fire Protection (BOF) to declare a Zone of Infestation for native and exotic insect and disease pests. This enables them to go on private lands to attempt pest eradication or control. In 2010 there were Zones of Infestation declared for bark beetles in the Lake Tahoe basin and the Southern California Mountains.

The amount of forest pest damage in the Sierra, though notable, has not reached the scale of impacts found elsewhere such as the Southern California Mountains. Areas of high priority are small and localized. The five communities in the Sierra Nevada with the most acres needing mitigation to restore pest damaged forests are all found at elevations above 4,900 feet (see Table 2). Truckee in Nevada County has the most acres of high priority for action to protect public safety with 550, comprising 3% of the acres within the community. Bear Valley in Alpine County has fewer high priority acres to treat at 263, but this makes up 8% of the community's acres (see Figure 17).

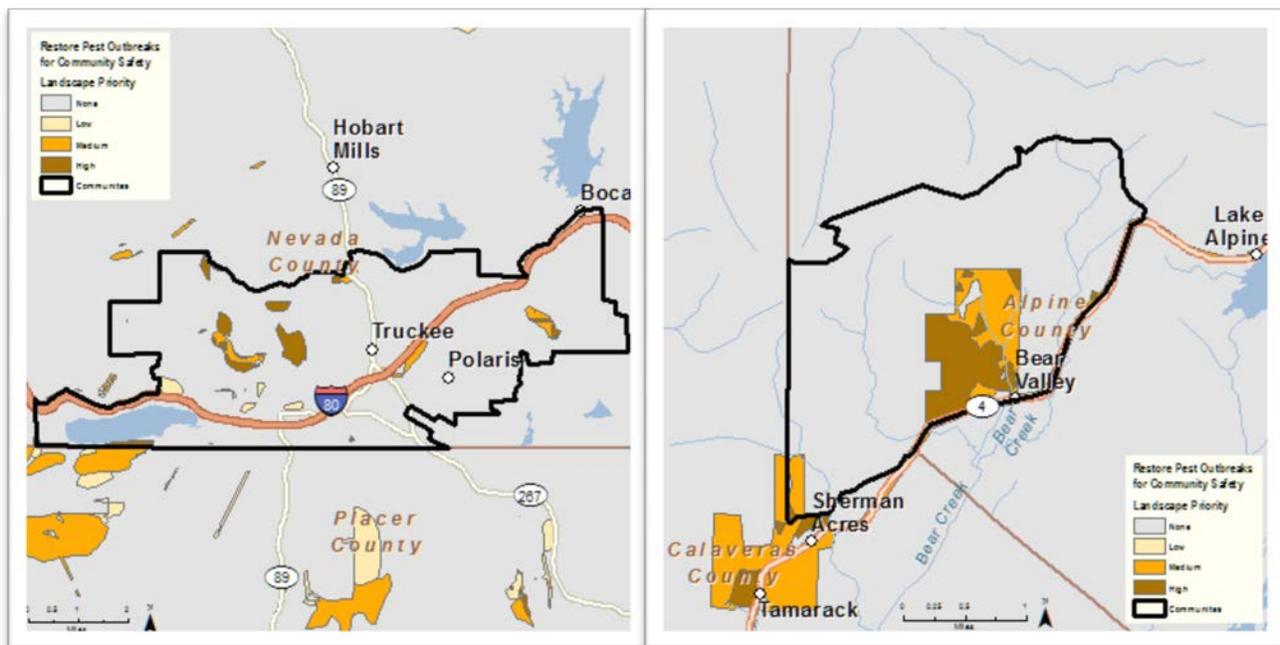


Figure 17. Community acres prioritized for restoration of pest damage for community safety

Table 2. Top five communities with high priority landscape area for restoring forest pest impacts for public safety

Community – County Population Elevation (feet)	Priority Landscape Acres Percentage				Total Community Acres
	None	Low	Moderate	High	
Truckee – Nevada 16,000 5817'	20,510 95%	172 1%	317 1%	550 3%	21,550
Bear Valley – Alpine 120 7100'	2,768 84%	7 0%	272 8%	263 8%	3,310
Plumas Eureka – Plumas 320 6014'	2,327 92%	45 2%	103 4%	50 2%	2,526
Mineral – Tehama 120 4918'	27,976 98%	397 1%	69 0%	29 0%	28,470
Shaver Lake – Fresno 630 5627'	21,459 97%	493 2%	206 1%	22 0%	22,180
Grand Total	878,258	3,768	2,253	1,019	885,297