



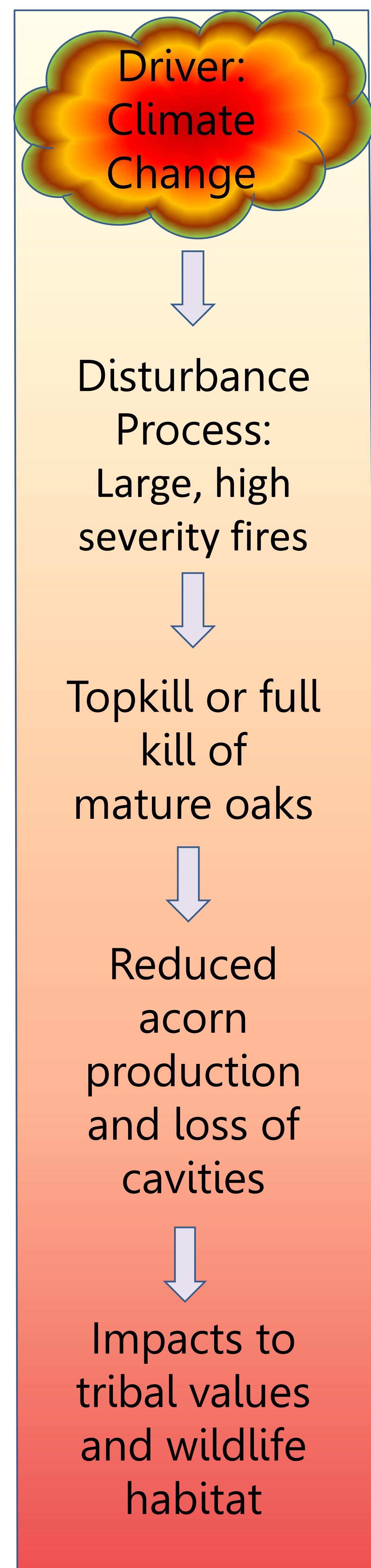
USDA Forest Service  
Research and Development

# Fate of California Black Oaks in High-Severity Wildfires

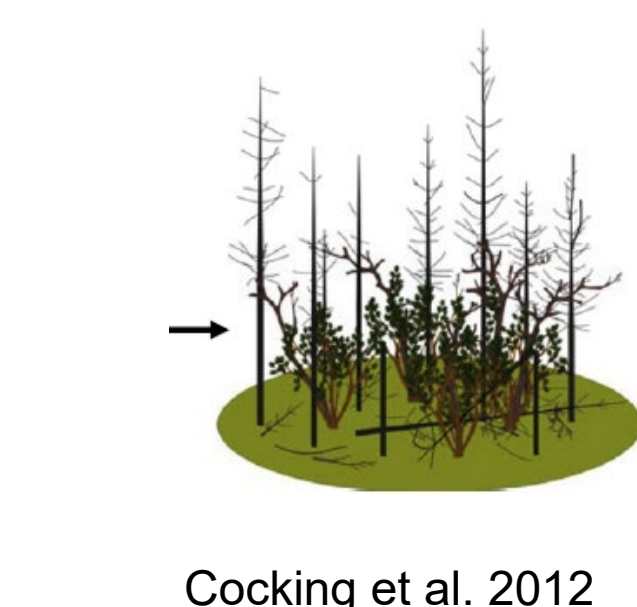
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## The Problem

Large fires with extensive patches of high severity have become more common in the Sierra Nevada, and more such disturbances are expected with climate change.

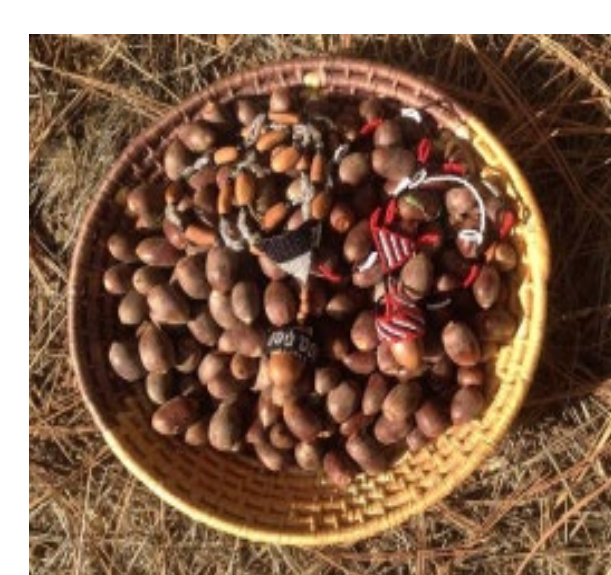


Mature California black oak trees are vulnerable to high severity fires, even though they can resprout.



Oaks within high-severity burn patch in the Rim Fire

**Black oaks need ~30 years to produce acorns, and do not consistently yield large acorns until 80-100 years.**



## Study Areas



We studied responses of black oaks to the Rim Fire of 2013 and the King Fire of 2014.

A companion study is evaluating recovery in the Power Fire of 2004.

## Research Questions

We hypothesized that large and very large black oak trees would decline sharply in severe patches but not in low severity patches, with intermediate survival in moderately burned areas.

We also are exploring:

1. Which factors influence oak presence in mixed-conifer vegetation types?
2. Which factors influence oak growth form, and
3. Which factors other than burn severity influenced oak mortality?

## Sampling Methods

We sampled forest structure at 3-4 randomly selected points spaced at least 200 m apart within a 1-km belt transect. Two nested plots with radii of 11.3-m (0.04 ha plot) and 16-m radius (0.08 ha plot) were delineated using four transects laid out from the center point in each cardinal direction. In the inner plot we estimated the percent cover of live vegetation for the following categories: tree seedling/saplings (DBH <7.6cm), shrubs, herbs, bare ground, rocks, and litter. In the outer plot we recorded the following on every tree or snag (DBH ≥ 7.6cm): species (if possible); DBH; height; decay class; and whether live top, basal resprouting, or dead.



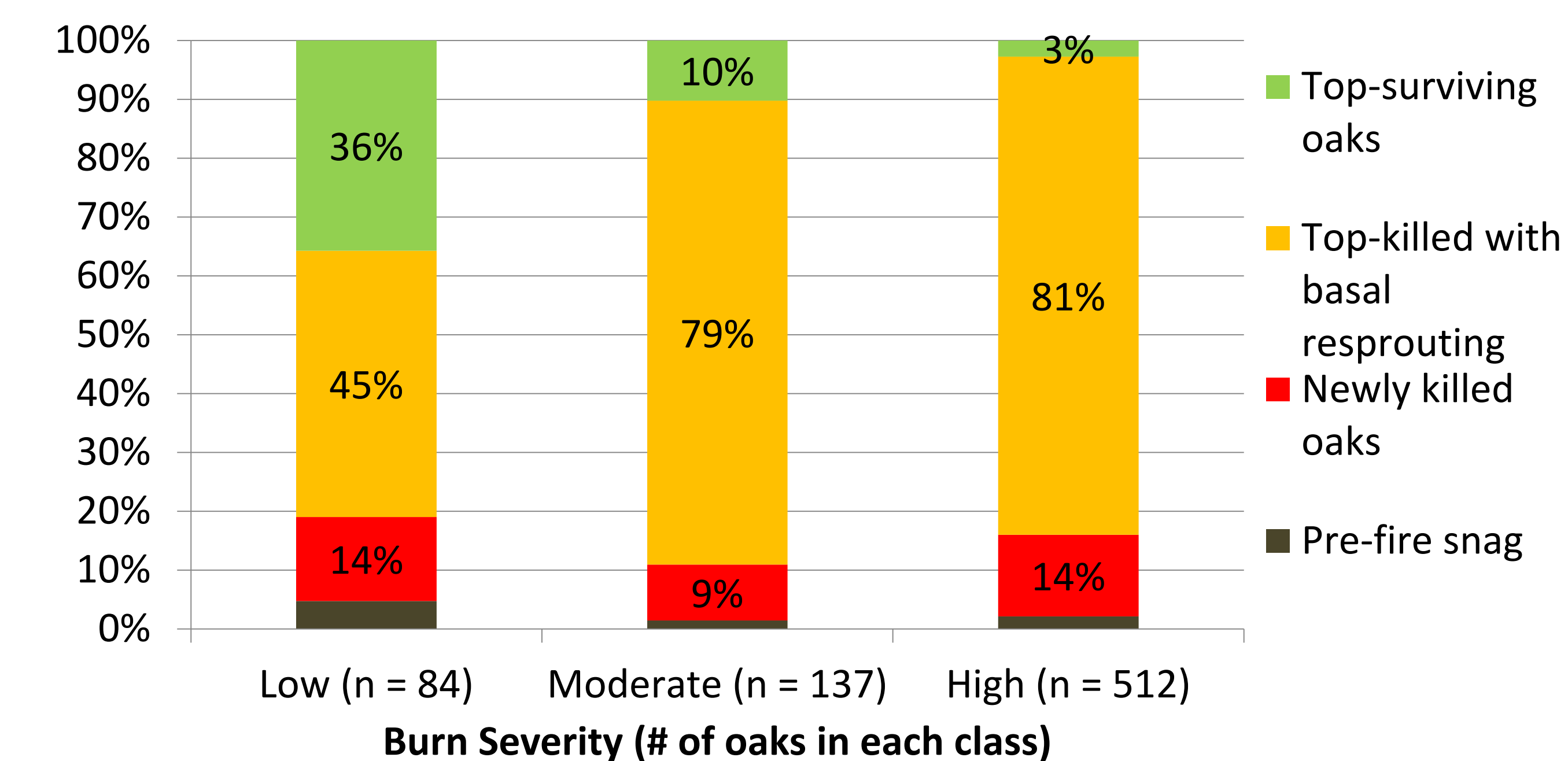
## Results

- 443 black oaks in 192 1/5 acre plots → (11.5 trees/acre).
- Mean DBH: 29.69 cm
- Max DBH: 137.7 cm
- Mean height: 12.5 m
- Maximum height: 34 m
- Oaks were found more on higher slopes (nearing 30%) than in flat areas
- Associated with lower density of small (6-11" DBH) and medium size (11-24" DBH) conifer trees.



Fully-killed (left) and top-killed only (right) oaks in Rim Fire

Within the Rim Fire, we found that both moderate and high-severity patches resulted in high rates (~80%) of top-kill of oaks with <10% survival rates initially. About 9-20% of black oaks appeared to be fully killed across burn severity classes.



Fate of black oaks in different burn severities in the Rim Fire

We continue to analyze data to evaluate influences on oak growth form and mortality.

## Summary

- In the mixed-conifer forests were surveyed, oaks trended to be tall and spindly, reflecting competition for sunlight with conifer trees, rather than having qualities desired for acorn harvest.
- The fires resulted in extensive top-kill of mature black oaks in moderate-high severity patches
- These effects will diminish key services including acorn production for decades or longer as mature oak trees are replaced by resprouts.
- Active management may promote resilience to fire and maintaining services, both before and potentially after, large fires.



Mature black oak burned in King Fire