

Protecting your home from wildfire

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Most destructive fires in California since 2017

- Tubbs Fire (2017) – 5,636 structures
- Carr Fire (2018) – 1,614 structures
- Camp Fire (2018) – 18,804 structures
- Woolsey Fire (2018) – 1,643 structures
- North Complex (2020) – 2,352 structures
- Palisades Fire (2025) – 6,833 structures
- Eaton Fire (2025) – 9,413 structures



Photo: CAL FIRE



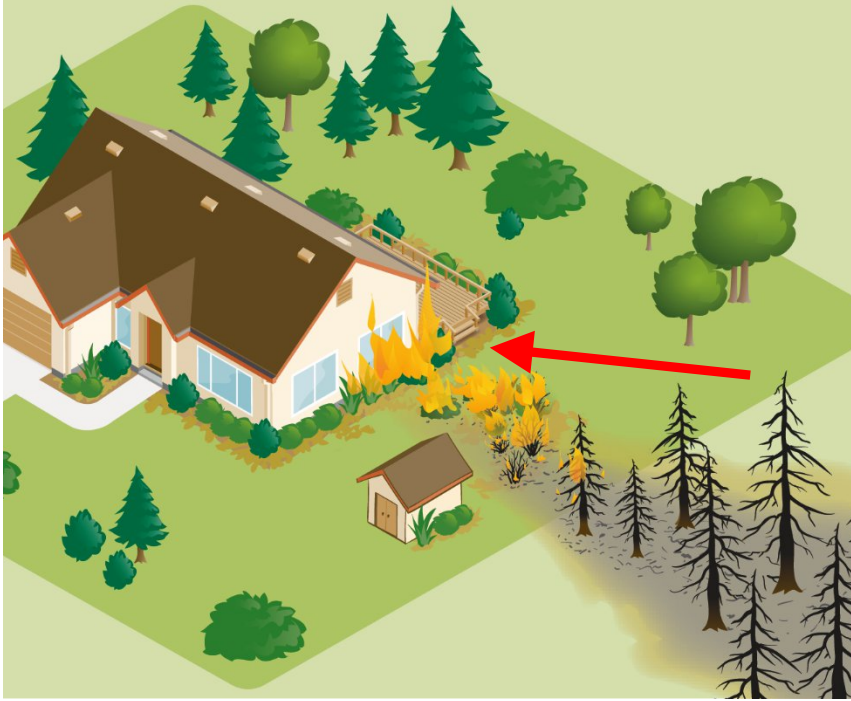
Video courtesy of TD-136, 15:07.
Used with permission.
Composite image by NIST.

Outline

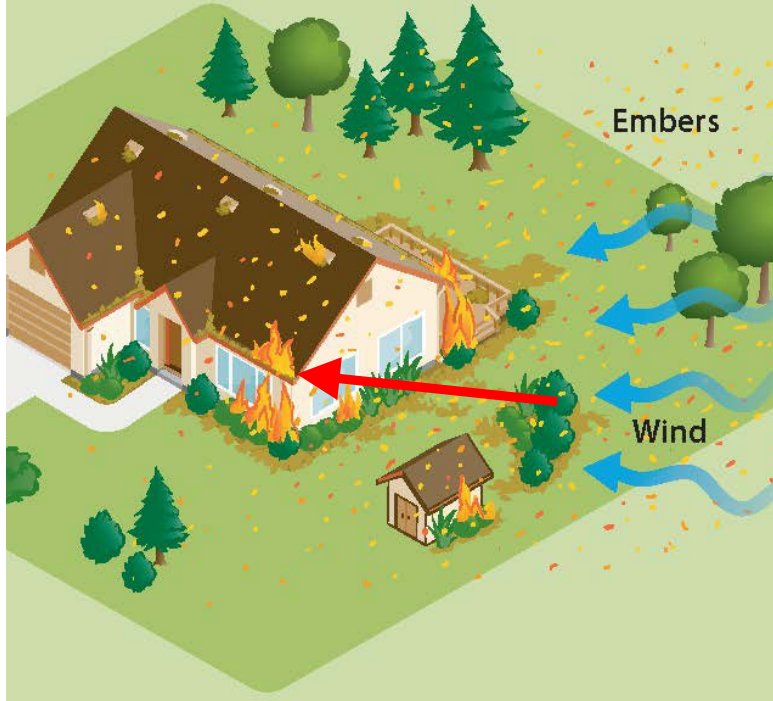
- Reasons why homes are lost in wildfires
- What can we learn from homes that survived?
 - Analyses from the 2018 Camp Fire
- Recommendations for living in a fire-prone environment

Three types of fire exposures

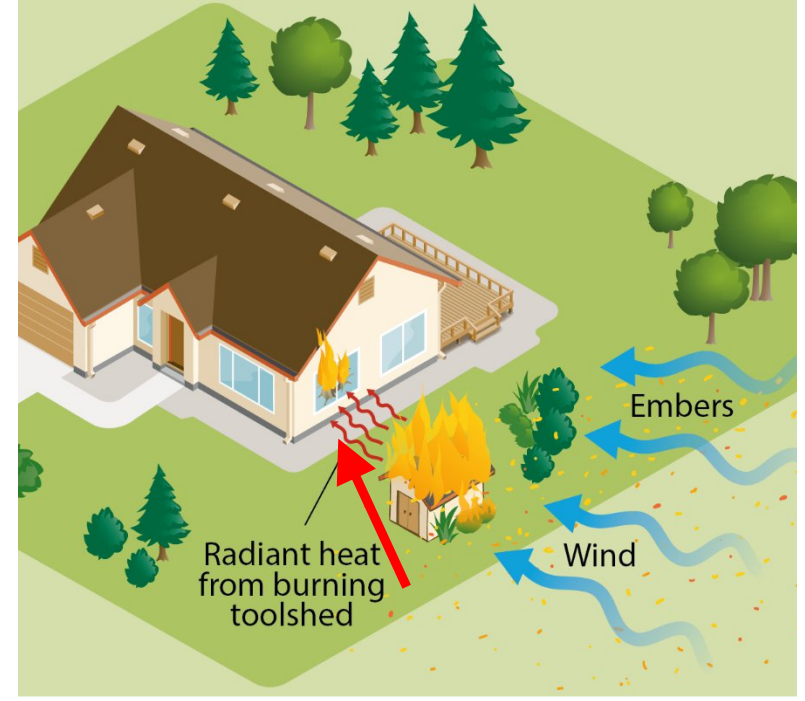
Direct flame contact



Embers



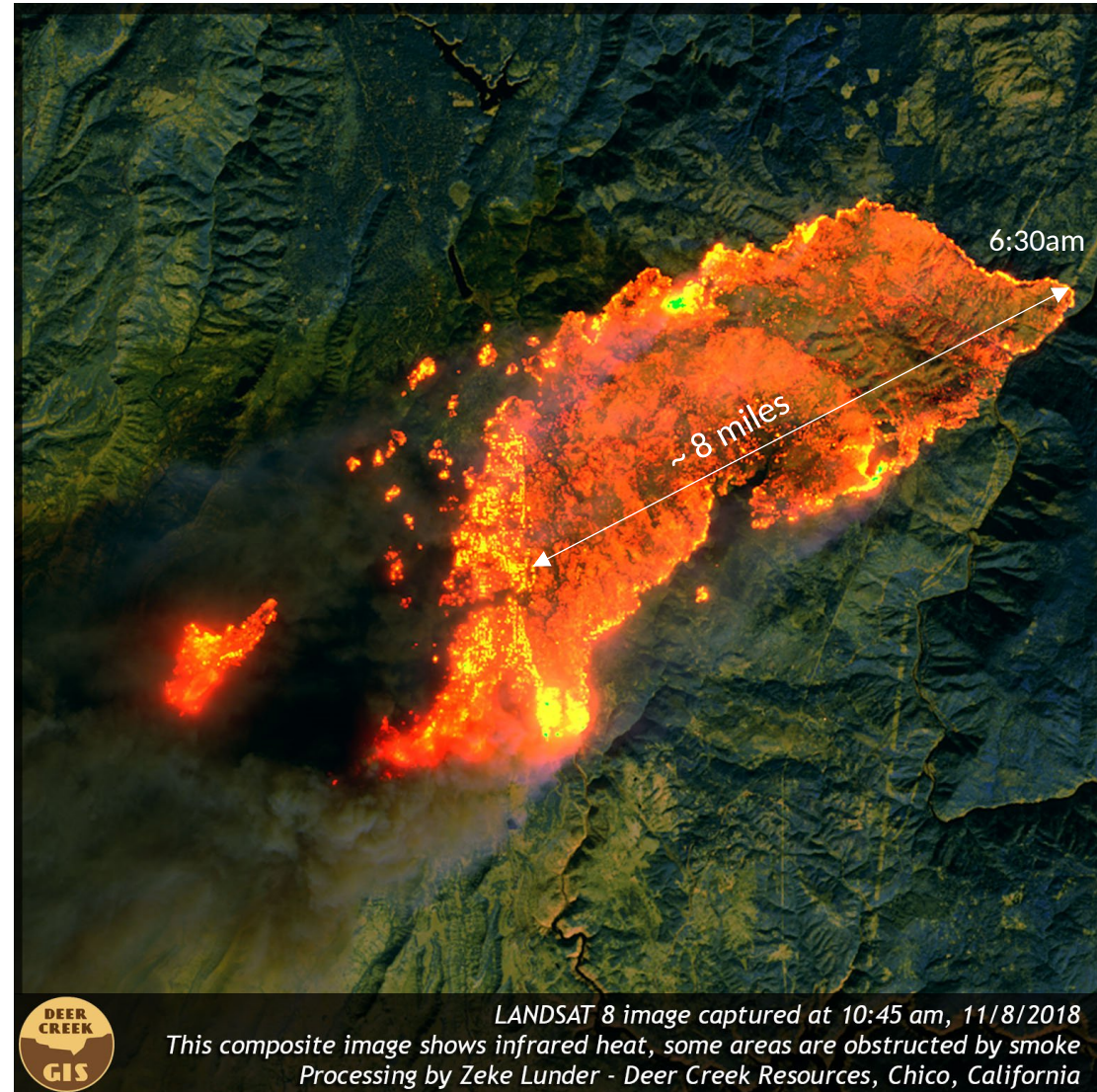
Radiant heat



- Educational messages have mostly focused on reducing direct flame contact through defensible space.
- Preparing for embers and radiant heat exposures requires different approaches.

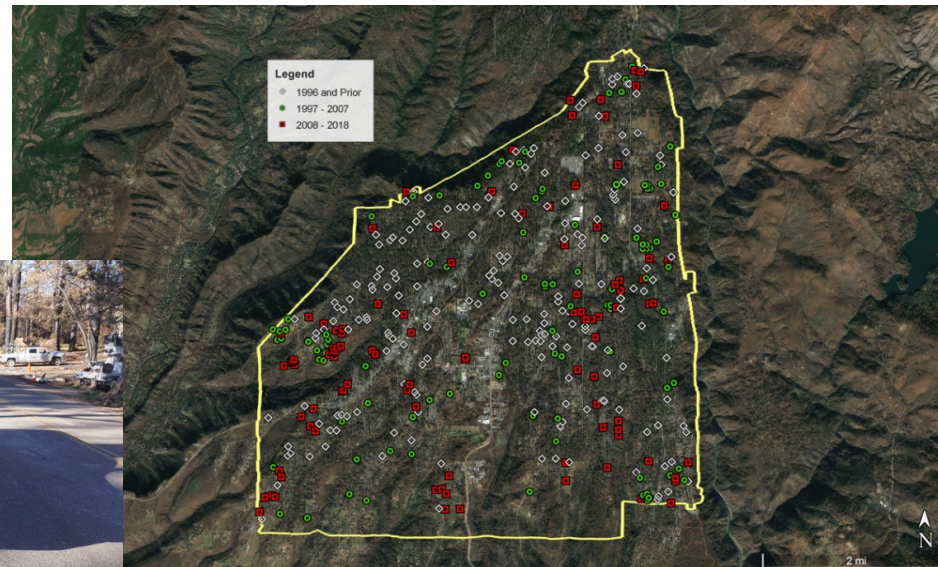
2018 Camp Fire: behavior and progression

- Extreme ember-driven rates of spread
- Flaming front ~5 miles wide when the fire hit Paradise
- Structure to structure fire spread



Methods

- Questions:
 - Was home survival related to fuels associated with nearby vegetation?
 - Did proximity to nearby burning structures influence home survival?
 - Did CA building code update (2008) improve odds of survival?



Analyses and Results

Significant variables:

Construction time period: <1997, 1997-2007, 2008-2018

Distance to nearest destroyed structure x Time period

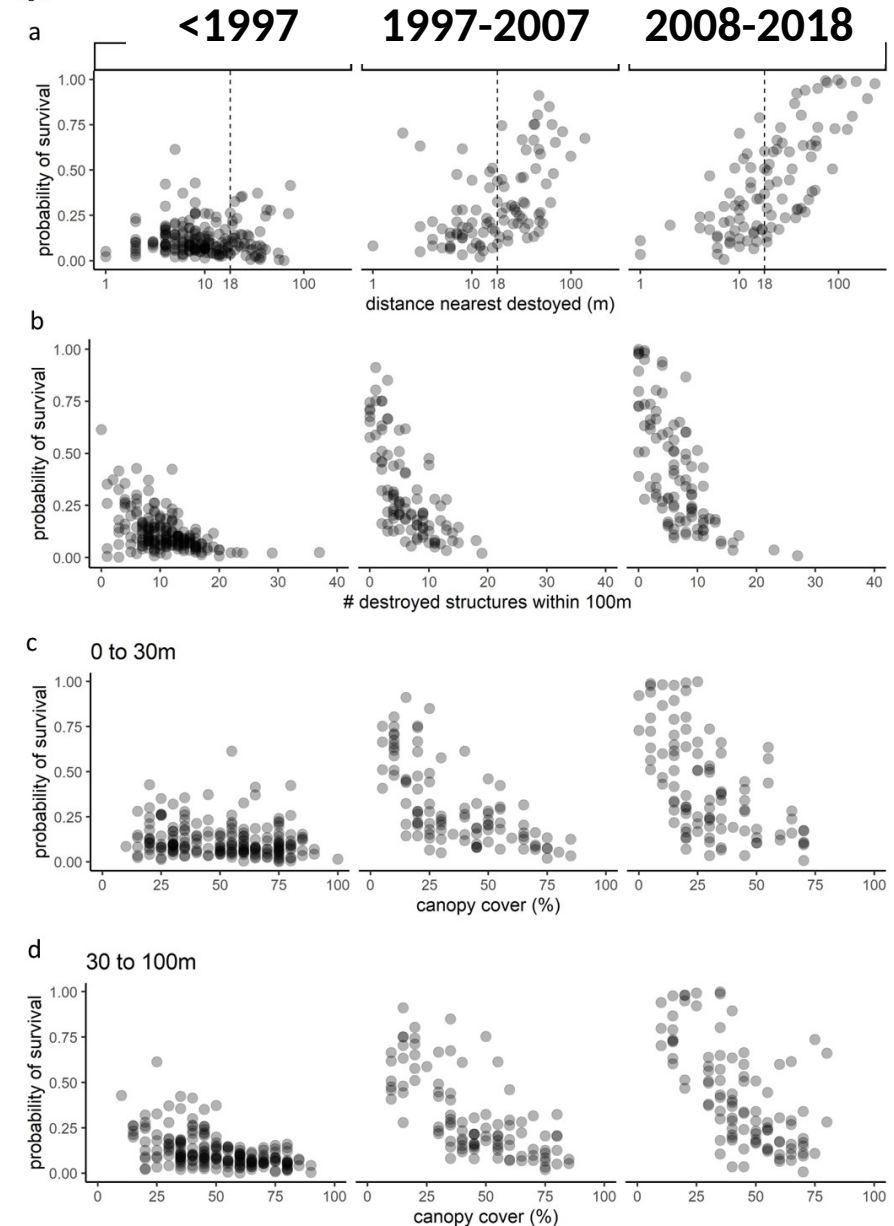
Total structures destroyed within 100 m

Overstory canopy cover 0-30 m x Time period

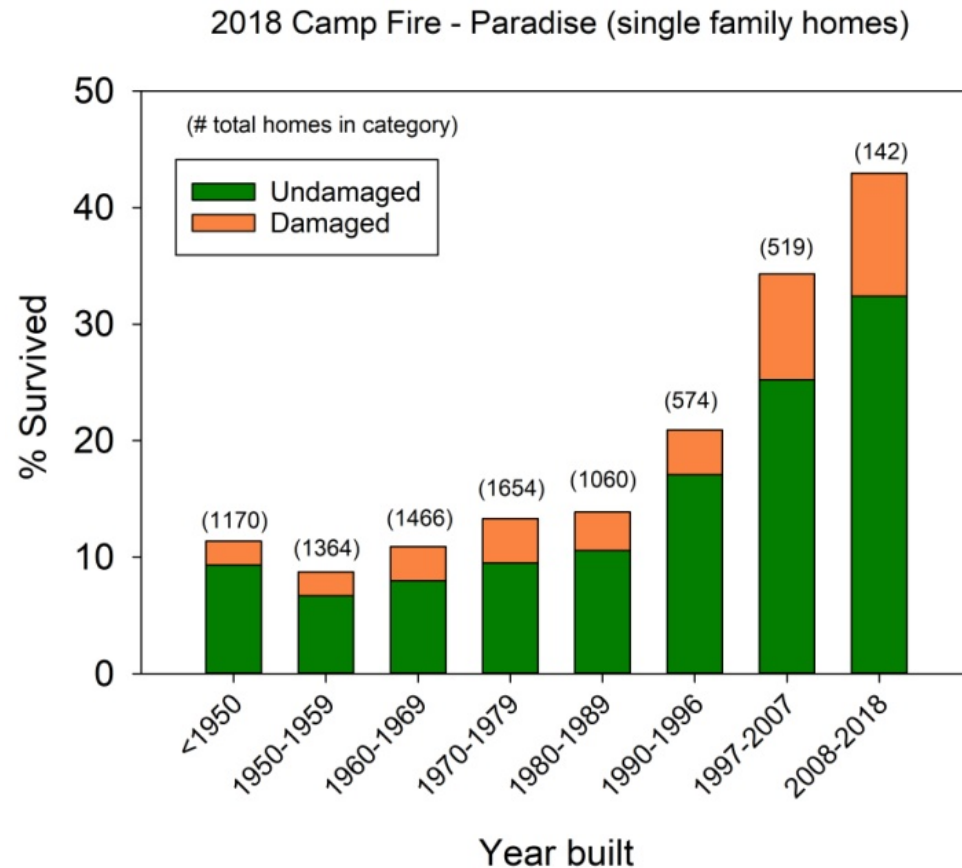
Overstory canopy cover 30-100 m

- Neighboring structures on fire, surrounding vegetation, and home age all matter!
- Strength of relationships weaker for older homes – why?

Fig 3



Was 2008 building code update associated with higher survival?



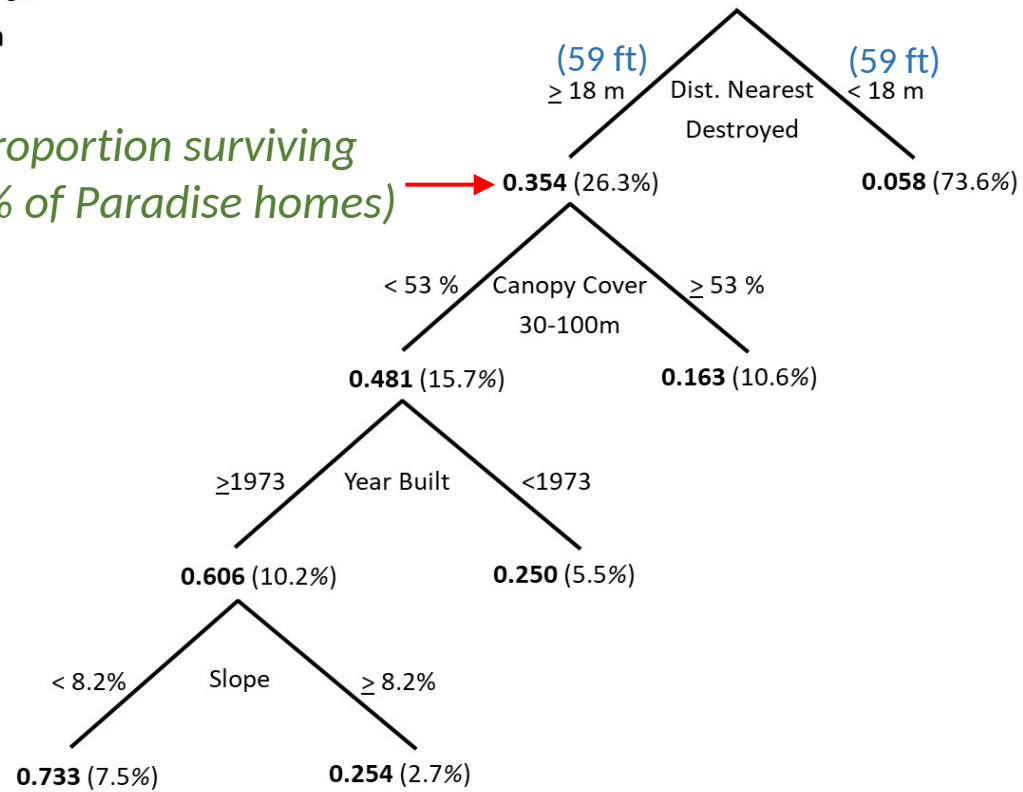
- (Prior to 1997: 11.5%)
- 1997-2007: 37%
- 2008-2018: 44%
- $P = 0.309$

Decision tree

Fig 5

a

*Proportion surviving
(% of Paradise homes)*



Wildland fuels and structure fuels



Wildland Urban Interface



Wildland Urban Intermix

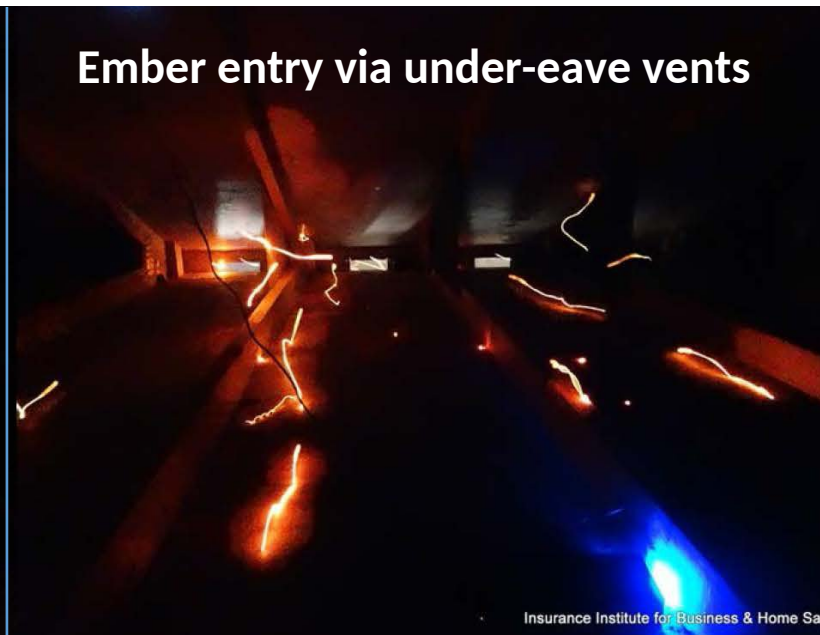
| | |
|-----------------------------------------------------|-----------------------------------------------------|
| Home survival = 16% | Home survival = 29% |
| Ave. canopy cover 0-30m: 43% | Ave. canopy cover 0-30m: 42% |
| Ave. canopy cover 30-100m: 42% | Ave. canopy cover 30-100m: 49% |
| Ave. distance to nearest destroyed structure: 36 ft | Ave. distance to nearest destroyed structure: 79 ft |

Structure ignition in wildfires

- **Myth** - giant wall of flames from nearby vegetation
- **Reality** - wind-blown embers are responsible for the majority of structure ignitions



Vulnerable locations



Embers photographed from inside an attic at the IBHS lab.

High vegetation burn severity \rightleftarrows Home destruction



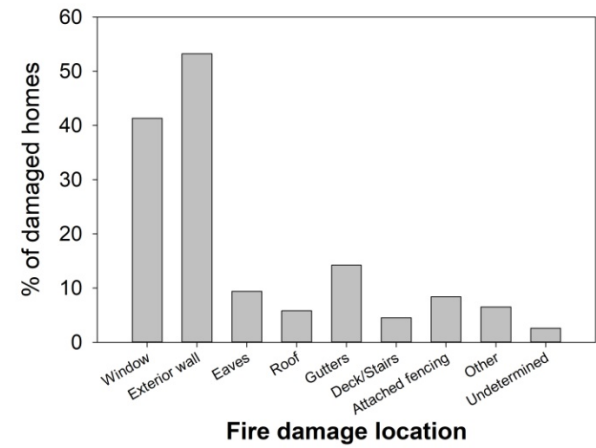
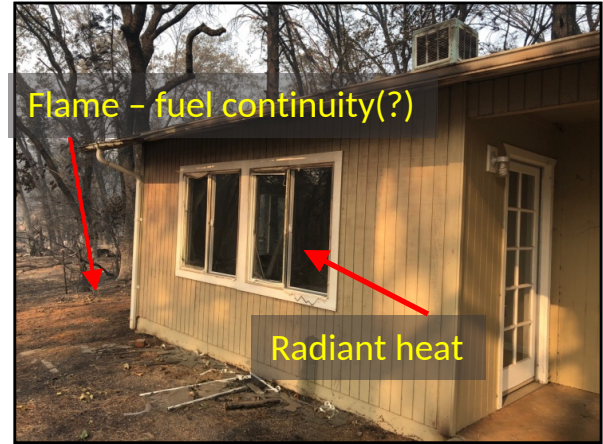
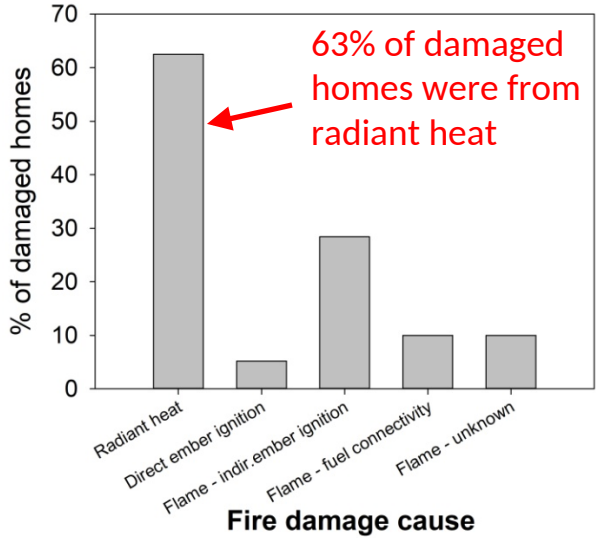
Photo: Owen Bettis

Mechanisms: why do homes with high surrounding tree cover typically fare worse?

- Threat is in many cases indirect
 - Leaf litter in gutters, on roofs, and around home; dead and down fuels
- Live vegetation is typically > half water; must be dried out before it will ignite and become fuel
- Often more a maintenance issue than a tree issue
 - Clean up leaf litter and other fuels underneath
 - Prune lower branches
 - Gutter guards



CAL FIRE Damage Inspection (DINS) – damaged homes



Photos: CAL FIRE

Location (and cause) of fire damage



What can we learn from this close call?

- Likely ember ignition of leaf litter under shrubs
 - Fire entered wall and heat broke a window
- Possible solutions
 - Move vegetation farther from house
 - Plant vegetation that is less dense and easier to clean up under
- Another vulnerability: wooden fence to wall



Example: a home that survived unscathed

- No combustibles near home
- Tree near home, but litter cleaned up
- Succulents (high moisture content) under manzanita
- Manzanita: pruned, open, dead material removed



Photo: Yana Valachovic

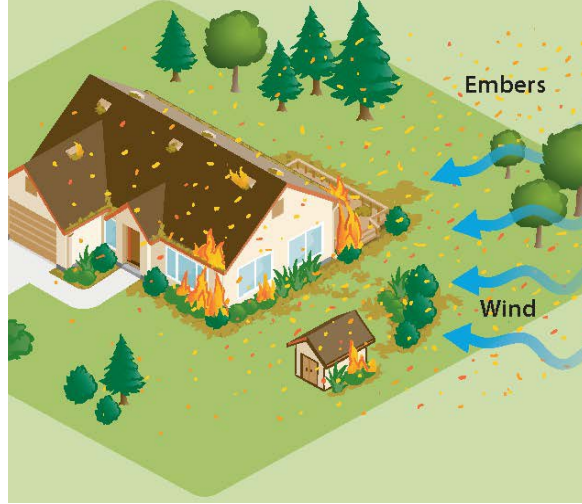
Protecting your home from wildfire: take home points

Direct flame contact



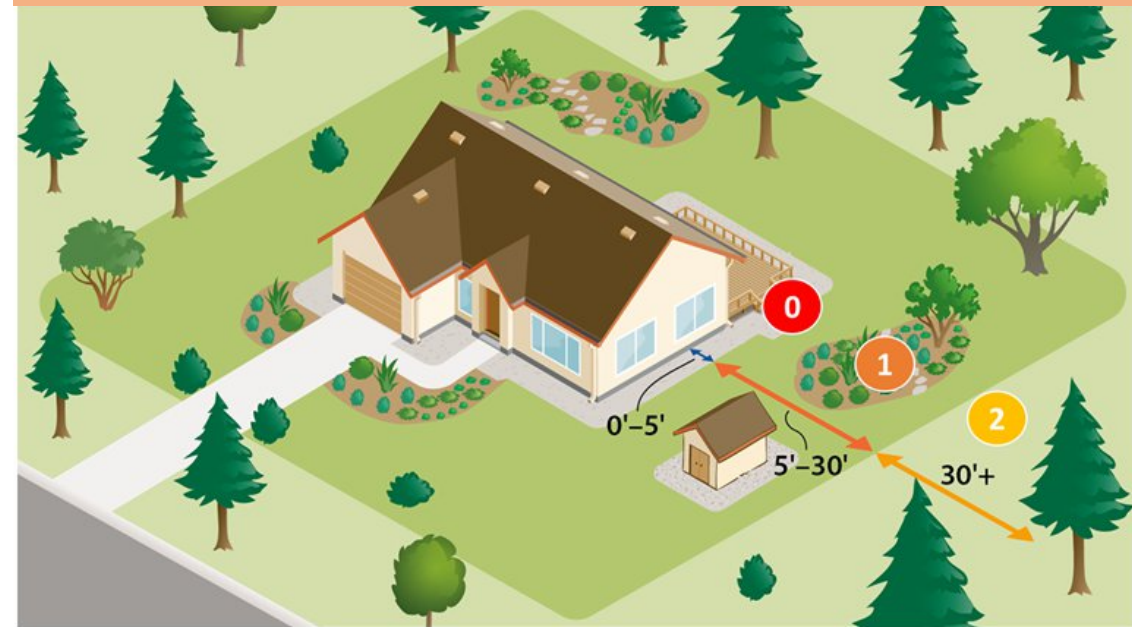
- Surface fuel management in surrounding wildlands
- Good defensible space
- No bark mulch or wood fence 'wicks' to house

Embers



- Remove near home fuels
 - Bark mulch
 - Leaf litter
 - Stored objects
- Clean gutters
- Ember-proof vents

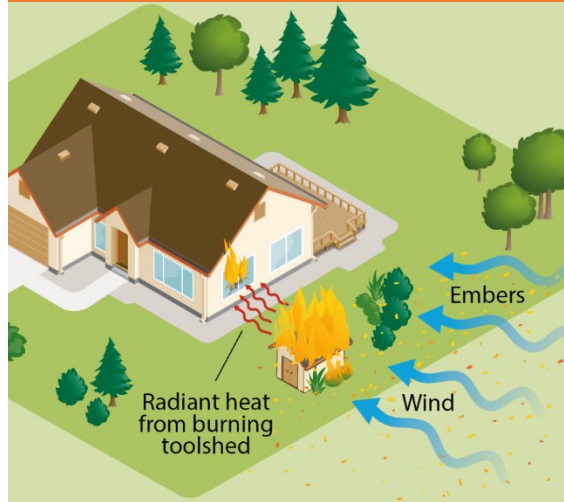
5 ft non-combustible zone



“Zone 0” will apply to homes in high fire hazard zones

Protecting your home from wildfire: take home points

Radiant heat



- Apply same fire safe principals to sheds and other outbuildings
- Practice fuel reduction at the neighborhood scale
- For surfaces in close proximity to neighbors:
 - Tempered glass in both window panes
 - Window shutters
 - Non-combustible siding

Acknowledgements

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Rebuilding Paradise
(3 years post Camp Fire)