CALIFORNIA FIRE SCIENCE CONSORTIUM

JOINT FIRE SCIENCE PROGRAM

Research Brief for Resource Managers

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A model for predicting early postfire mortality in four important redwood community plants.

Woodward, B.D., Romme, W.H. and Evangelista, P.H., 2020. Early postfire response of a northern range margin coast redwood forest community. Forest Ecology and Management, 462, p.117966.
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Management Implications

- Very low to low severity fire may achieve beneficial effects in redwood forests with similar species composition, reducing understory competition while retaining larger trees of all focus species.
- Moderate severity fire may top-kill large DBH tanoaks (>17cm) and Douglas-fir (>21cm).
- Thresholds outlined in these decision-tree models can inform forest management and prescribed fire goals and prescriptions in similar forests.
- Composite Burn Index (CBI) should be used in future post-fire research and monitoring to maintain continuity with other studies.
- Due to high survivability of larger redwoods, avoid early salvage logging in these systems of trees larger than 30cm DBH.

The fire history of a redwood forest is written on the trunks of its oldest trees. These fire scars tell a story of mixed-frequency, and mixed-severity fires across the redwood range. Historically, a naturally moist climate and fire suppression efforts have kept fire relatively rare in these forests. However, with projected increases in fire frequency and severity across the western US, understanding how these ecosystems respond to fire is increasingly important to forest managers.

In 2017, the Chetco Bar Fire burned into some of the northernmost stands of coast redwood forest within the Wheeler Creek Research Natural Area in Oregon. The fire burned both old growth and second growth forests across a wide range of severities. Researchers used this opportunity to measure the post-fire survival of four important redwood community plants: coast redwood (*Sequoia sempervirens*), coast Douglas-fir (*Psuedotsuga menziesii* var. *menziesii*), tanoak (*Notholithocarpus densiflorus*) and coast rhododendron (*Rhododendron macrophyllum*). The data was then used to create simple models for predicting mortality based on burn severity with 80-88% accuracy.

Composite Burn Index (CBI) was used to assess burn severity at the community level. A CBI of 0 represents unburned, while a CBI of 3 represents the highest severity fire. Not only does CBI consider the impact of fire across 5 strata, all represented in this forest type, it also aligns this study with similar post-fire research, helping to establish a standard for discussing postfire response in redwood forests.

Coast redwood displayed the greatest survivability, with no absolute mortality regardless of burn severity or size. Redwoods over 30cm diameter at breast height (DBH) retained their canopies up to a CBI of 1.5, and almost all the trees of this size were able to resprout epicormically even after high severity fire. Smaller individuals consistently resprouted from a basal burl (Figure 1). Due to these traits, the authors caution against early salvage logging in redwood systems. Mortality is hard to decern in the first year following a fire, so if the intention of the salvage operation is to only harvest dead stems, researchers suggest avoiding extraction of stems over 30cm DBH.

Douglas-fir individuals larger than 21cm DBH resisted fire up to moderate severity. Without the ability to resprout, smaller individuals were killed at all burn severities. However, even the large Douglas-fir died at CBI greater than 2.0.

Tanoaks displayed very little resistance to fire at any severity. Large tanoaks (>17cm) only retained their parent stem and canopy if burn severities were very low. Trees of all sizes were top-killed and resprouted basally if burn severity was greater than 1.2 CBI.

Coast rhododendron had the least resistance to fire at all severities. While some individuals were left unaffected, even very low burn severity (CBI <1.0) killed most parent stems, causing individuals to sprout from their basal burl. Absolute mortality followed no discernable pattern in either tanoak or coast rhododendron.

With three of the four species in this study vigorously sprouting in response to fire, this redwood forest community shows high fire resilience. However, the variation in the fire resistance of each of these species has implications for forest and fire management. For example, coast rhododendron's susceptibility to fire of any severity may enable managers to use fire to reduce its cover even under cool burning conditions, allowing for regeneration of other important less shade-tolerant species. Additionally, the high susceptibility of all tanoaks to any but very low severity fire can help managers choose prescriptions and burn windows to minimize or maximize mortality of trees of certain size classes depending on management goals. The thresholds outlined in the decision-tree models provide guidelines for management actions (Figure 2).

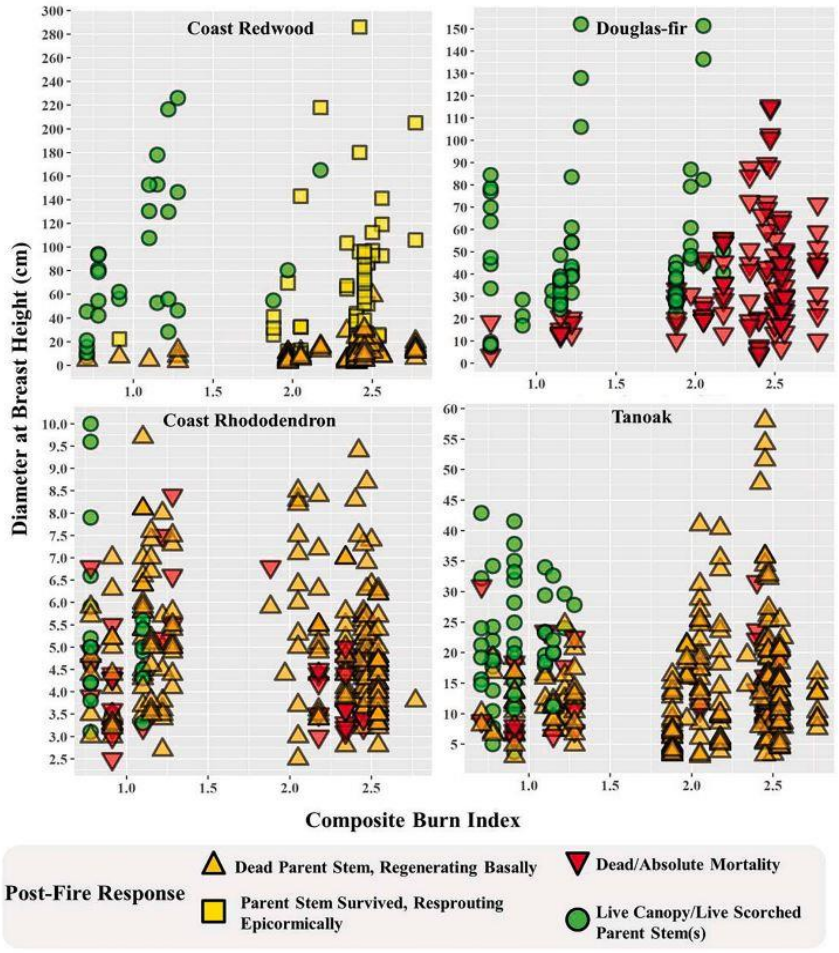

Figure 1: The postfire response of sampled species across the spectrum of diameters at breast heights (DBH) and burn severities, represented by Composite burn Index (CBI).

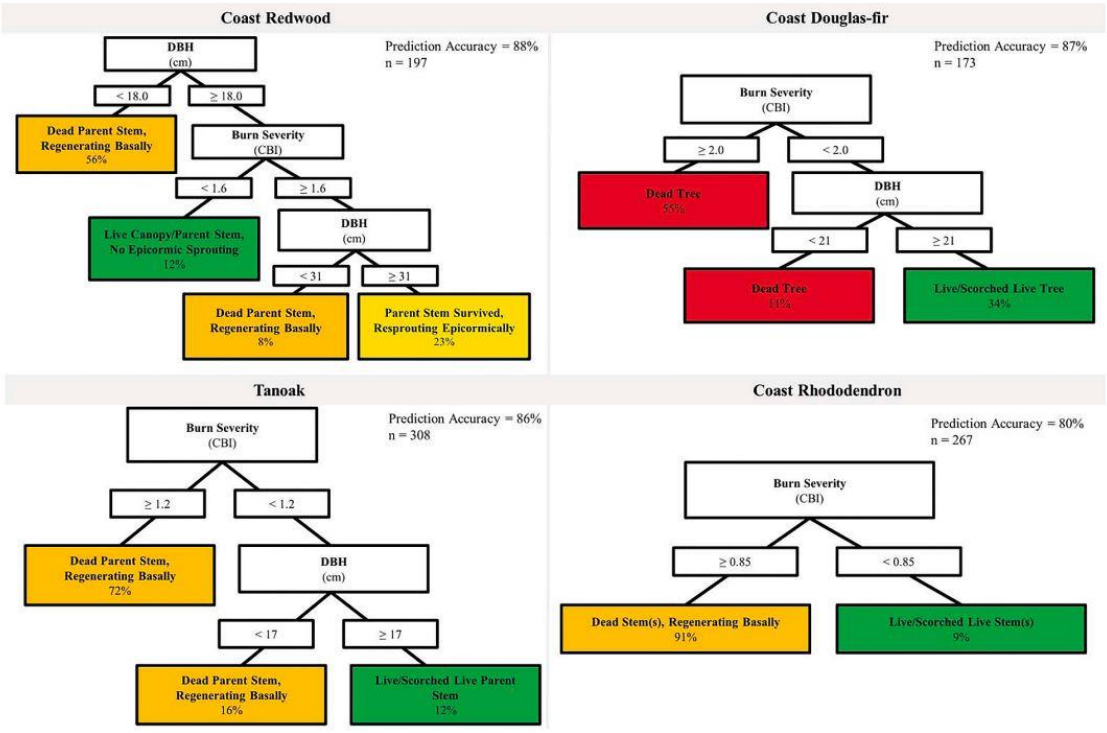

Figure 2: Recursive partitioning models represented as decision trees of the four primary study species. Box colors correspond with those displayed in Fig.1 and percentages represent the proportion of observations from the training dataset in each individual node.