

Post-fire cypress germination was higher in low severity plots, an unusual finding for cypress.

Seedling survival rates after 9 years, however, were twice as high in high severity plots.

Do post-fire germination and survival of rare Baker cypress vary by fire severity?

Baker cypress is a rare, serotinous conifer known globally from only eleven locations in northern California and southern Oregon. Portions of the Burney population on the Hat Creek R.D., Lassen NF, burned in the 2014 Eiler Fire, providing an opportunity to ask whether post-fire germination and survival varied by fire severity.



Fig. 1. Baker cypress cone, opened by the 2014 Eiler Fire, surrounded by first-year Baker cypress seedlings.

Key Findings

- First-year seedling densities were higher in low severity plots (15 seedlings per square meter) versus high severity plots (4 seedlings per square meter).
- High light conditions (lower cover of snags and live trees) were associated with greater cypress survival. This condition was more prevalent in high severity plots.
- After nine years, 87% of seedlings had survived in high severity plots relative to 41% in low severity plots. Although seedling densities in all plots were sufficient to replace the parent population, high mortality rates in low severity plots may reduce population size over the long term.
- Low germination rates in high severity plots may have been due to unnaturally high fire intensities or durations that resulted from the legacy of intensive management (specifically, high densities of encroaching plantation pines).

Monitoring and Research

The second largest known population of Baker cypress (*Hesperocyparis bakeri*) is located near Burney Mountain, California, on the Lassen National Forest. Fifteen monitoring plots were established in the portion of the population that burned in the 2014 Eiler Fire (Fig. 2). These plots were part of a larger research study that evaluated post-fire germination response at four different Baker cypress populations across Northern California (Merriam and Bovee, in review).

Plots were monitored one, two, four, and nine years after the Eiler Fire. Monitoring included measurements of seedling density, fire severity, canopy closure, and ground cover. The goal of the study was to determine whether post-fire regeneration of Baker cypress varied by fire severity or environmental factors.

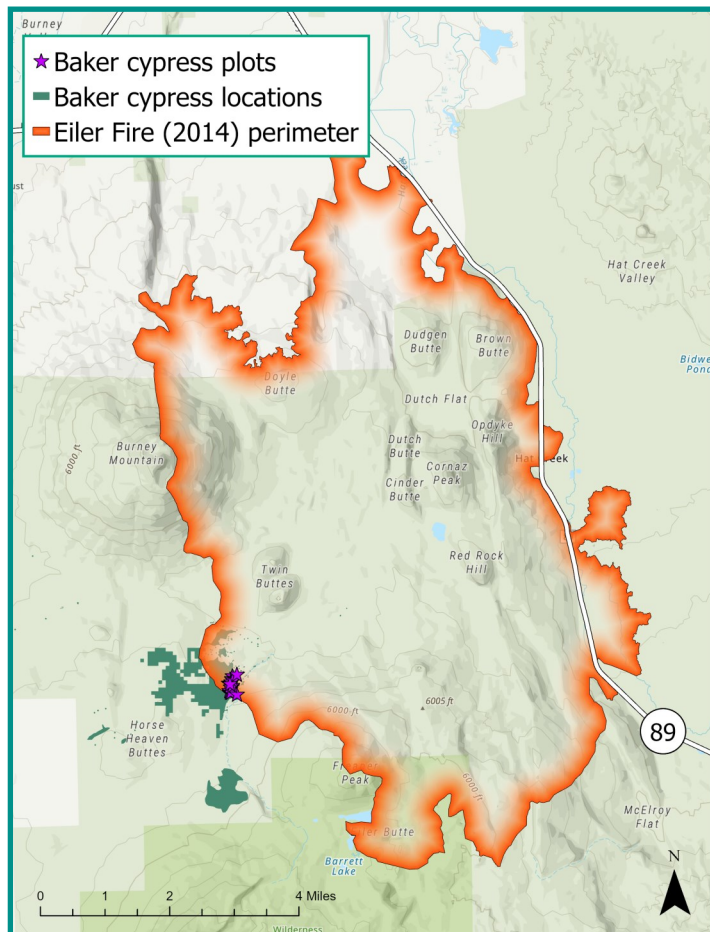


Fig. 2. Location of monitoring study within the Burney cypress population that burned in the 2014 Eiler Fire.



Fig. 3. Two year old Baker cypress seedling within a stand that burned at high severity in the Eiler Fire.

Site History

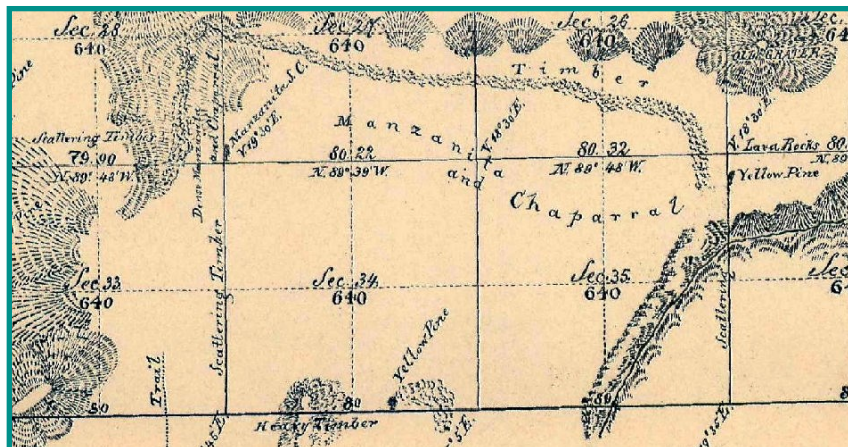
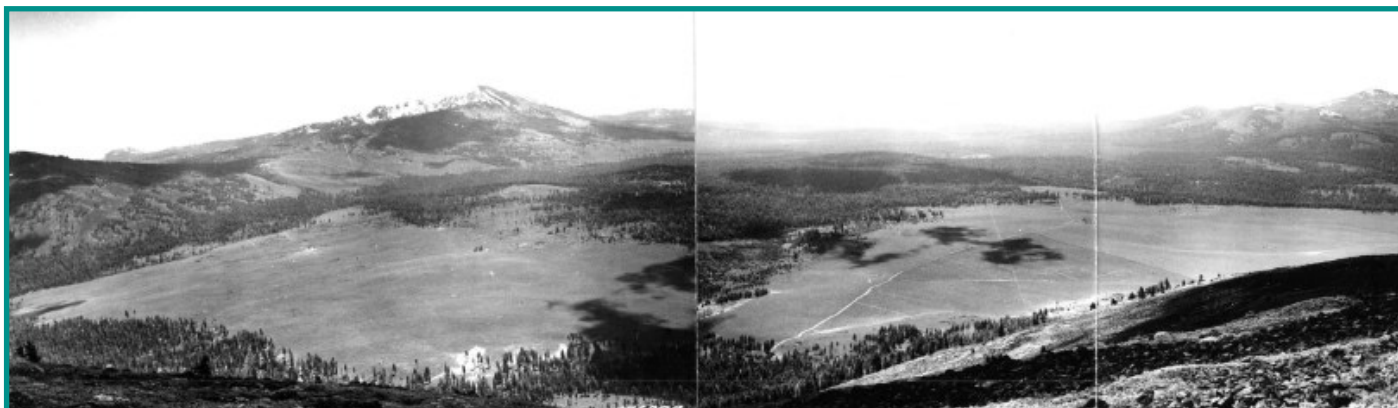


Fig. 4 (left). A 1878 General Land Office survey of the study area shows a vast expanse of montane chaparral.

Fig. 5 (below). A photo from the early 1930s looking south from Burney Mountain shows the large montane chaparral patch where the study area is located on the left.



The Burney cypress population is partially within the “Burney Reforestation Project,” an early 20th century effort to convert large expanses of montane chaparral (Fig. 5) into pine plantations. Prior to this intensive management, researchers noted that Baker cypress “was present as small bushy trees in a few discrete clumps” (Dunning and Kirk 1939). Montane chaparral vegetation was burned, bulldozed, and planted with pine in the 1930s. In the 1960s, vegetation and woody debris were pushed into long, linear strips (windrows) and pine trees were replanted between windrows. Despite these actions, Baker cypress persisted on the landscape and in some places spread to colonize the elevated windrows. By the 2010s, however, cypress was frequently shaded out by plantation pines (Fig. 6).

Fig. 6 (right). A photo from 2013, a year before the Eiler Fire, that shows a barely-visible Baker cypress tree overtopped by plantation pines.



Did germination differ by fire severity?



Cypress germination was lower in high severity plots, particularly where fire charring occurred along the entire height of cypress trunks.

Fig. 7 (left). Ecology crew monitoring a high severity plot one year after the Eiler Fire. A burned cypress tree is in the foreground, and shrub resprouting is visible in the understory.

We found significantly lower first year seedling densities in high severity plots (4 seedlings per square meter) versus high severity plots (15 seedlings per square meter), an unusual finding for Baker cypress.

Analysis of specific measures of fire severity found a significant negative correlation between char height and seedling density. Extensive charring of the tree bole can indicate high intensity fire and/or longer durations of fire exposure. Before the Eiler Fire, Baker cypress were overtopped by other conifers by an average of one and a half feet. As a result, some cypress seeds may have sustained lethal heating durations in Eiler's high severity plots, contributing to lower seedling densities in those plots. Although cypress cones require temperatures of 500 degrees Celsius for cone-opening, one study found that no germination was observed when seeds were exposed to heat for more than two minutes (Milich et al. 2012).

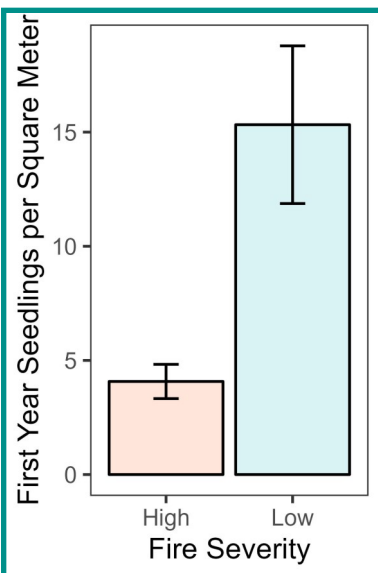
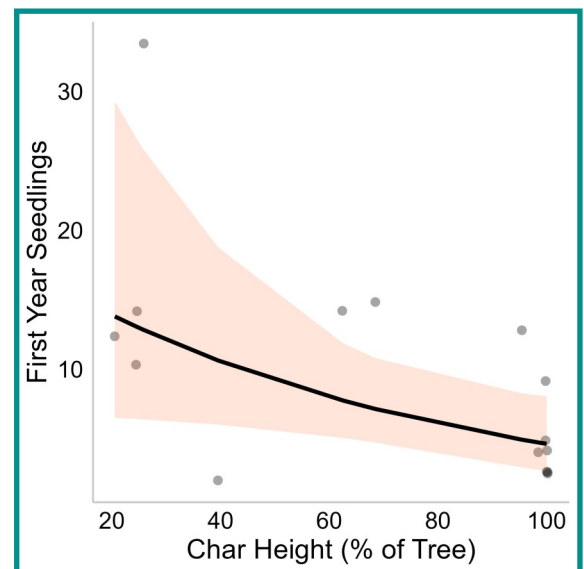
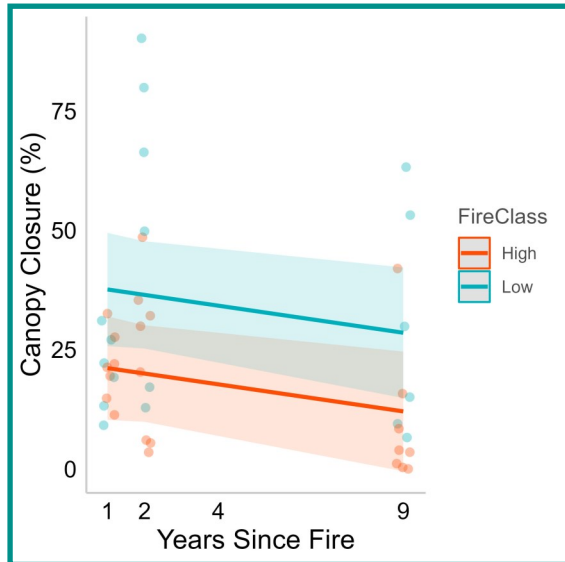


Fig. 8 (left). Cypress seedling density was significantly lower in high severity plots (error bars indicate standard error around the mean).

Fig. 9 (right). Char height was negatively associated with cypress seedling density.



Did light availability vary by fire severity?



We asked how the growing environment for cypress seedlings varied by fire severity. We found that while shade from live and dead trees decreased over time as snags fell, canopy closure remained higher in low severity plots that experienced less overstory tree mortality (Fig. 10). Light availability to cypress seedlings was therefore significantly greater in high severity plots.

Fig. 10 (left) Canopy closure decreased over time in all plots, but remained higher in low severity plots.



Fig. 11. This low severity plot retained 63% canopy closure nine years post-fire, reducing the amount of light available to cypress seedlings.



Fig. 12. This high severity plot had just 9% canopy closure nine years post-fire, with ample light available to growing cypress seedlings.



How did seedlings fare over time?

Although first year seedling density was over three times higher in low severity plots, survival was significantly greater in high severity plots. Nine years after the Eiler Fire, there were no significant differences in seedling density between high and low severity plots (Fig. 13). Densities in both high and low severity plots exceeded the threshold needed to replace the parent population killed in the Eiler Fire. However, higher mortality rates in low severity plots suggests that these areas may experience population declines over longer time frames. Seedlings were significantly taller in high severity plots after nine years (Fig. 14), suggesting greater vigor.

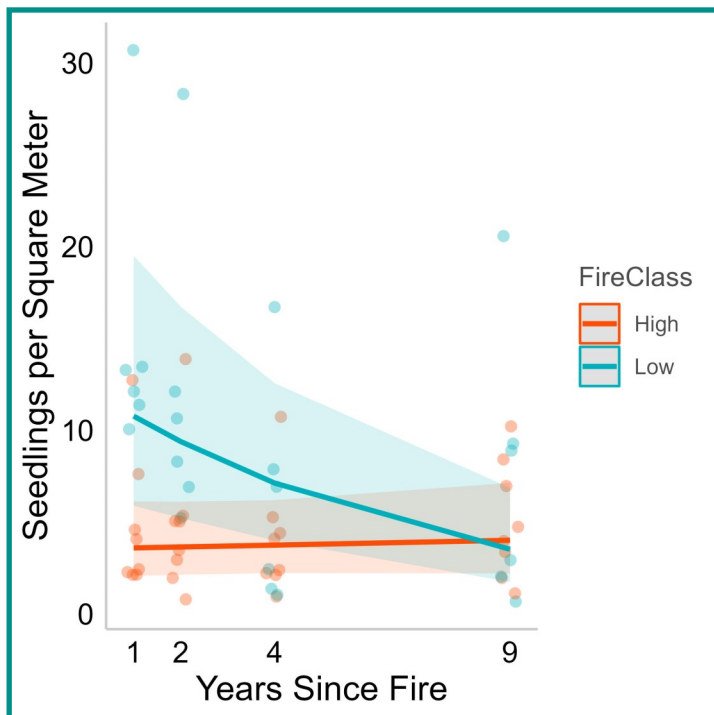


Fig. 13 (above). Although seedling density was initially higher in low severity plots, high mortality resulted in a significant decreasing trend over nine years.

Nine years post-fire, survival rates and seedling heights were greater in high severity plots.

Seedling density, after nine years, however, did not differ significantly by fire severity.

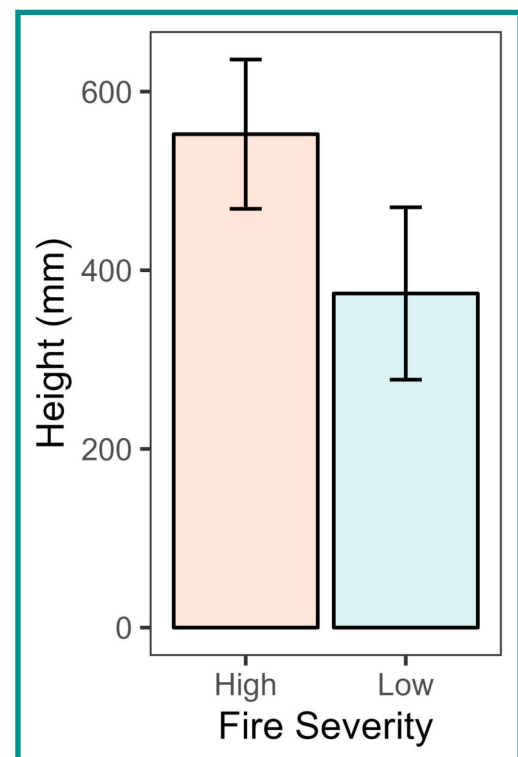


Fig. 14 (right). Nine years after the Eiler Fire, seedlings were significantly taller in high severity plots.

Conclusions

We found that high severity fire had mixed effects on Baker cypress seedlings, which experienced lower germination but higher survival in high severity plots.

The finding of lower germination in high severity plots may have reflected fire intensities outside of the tolerances of Baker cypress, perhaps a legacy of intensive plantation management that resulted in short-statured cypress, high densities of overtopping conifers, fire exclusion, and tall, dense shrub cover.

While the mean density of seedlings after nine years in both high and low severity plots exceeded the replacement rate for mature trees killed by the Eiler Fire, the trend of high mortality in low severity plots may lead to further mortality where seedlings are shaded.



Fig. 15. A dense patch of Baker cypress seedlings carpets the ground one year post-fire.



Management Recommendations

This stand now confronts a critical management need to minimize the risk of reburn before young cypress reach maturity. Delaying a reburn would allow time for the accumulation of sufficient cone storage to ensure that cypress recruitment would recur after a subsequent wildfire.

- Within the burned cypress population: Consider removal of fallen snags within the cypress population to reduce the risk of premature reburn. Minimize ground-disturbing effects to young cypress.
- Within the unburned cypress population: Complete Whittington Project planned thinning of other conifer species, particularly in the plantation, to promote cypress vigor and reduce densities of trees that not only compete with cypress for sunlight currently, but would result in high snag densities in a wildfire. Avoid mastication within cypress stands, which can result in unintentional damage or mortality to cypress saplings and small trees.
- Within adjacent stands: Complete Whittington Project planned thinning and fuels treatments, including mastication. This would provide a buffer around the cypress population and help prevent wildfire from entering the developing stand.

This project addressed the following monitoring question from the Burney Hat Creek CFLRP Ecological Monitoring Strategy:

BOT.1.2. How does wildfire severity affect Baker cypress regeneration and survival?

Literature Cited

Dunning, D. and B.M. Kirk. 1939. The Burney Spring Plantation: A reforestation experiment in the brushfields of Northern California. USDA Forest Service California Forest and Range Experiment Station. 65 pages.

Merriam, K., and K. Bovee. 2025. Complex effects of high severity fire on a serotinous conifer. In review.

Milich, K.L., Stuart, J.D., Varner, J.M., and Merriam, K.E. 2012. Seed viability and fire-related temperature treatments in serotinous California native *Hesperocyparis* species. *Fire Ecology* 8 (2): 107-124.