Research Brief for Resource Managers

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Prioritizing planting effort and heterogeneity in reforestation

North, M. P., Stevens, J. T., Greene, D. F., Coppoletta, M., Knapp, E. E., Latimer, A. M.,...& Young, D. J. (2019). Tamm Review: Reforestation for resilience in dry western US forests. Forest Ecology and Management, 432, 209-224. doi.org/10.1016/j.foreco.2018.09.007

A recent review by North et al. (2019) examines reforestation in western US forests and concludes that a new approach to planting may be warranted. In light of climatic trends, historic fire suppression, increasing incidence of large wildfires, and shrinking budgets, the authors propose a planting strategy that prioritizes accessibility, while reducing efforts within the dispersal range of seed trees and in areas with a high cost to probability-of-success ratio. Additionally, they emphasize the importance of spatial heterogeneity in planting, where seedlings are arrayed in configurations of widely-spaced individuals, clusters, and open spaces (“ICO”) (Fig. 1).

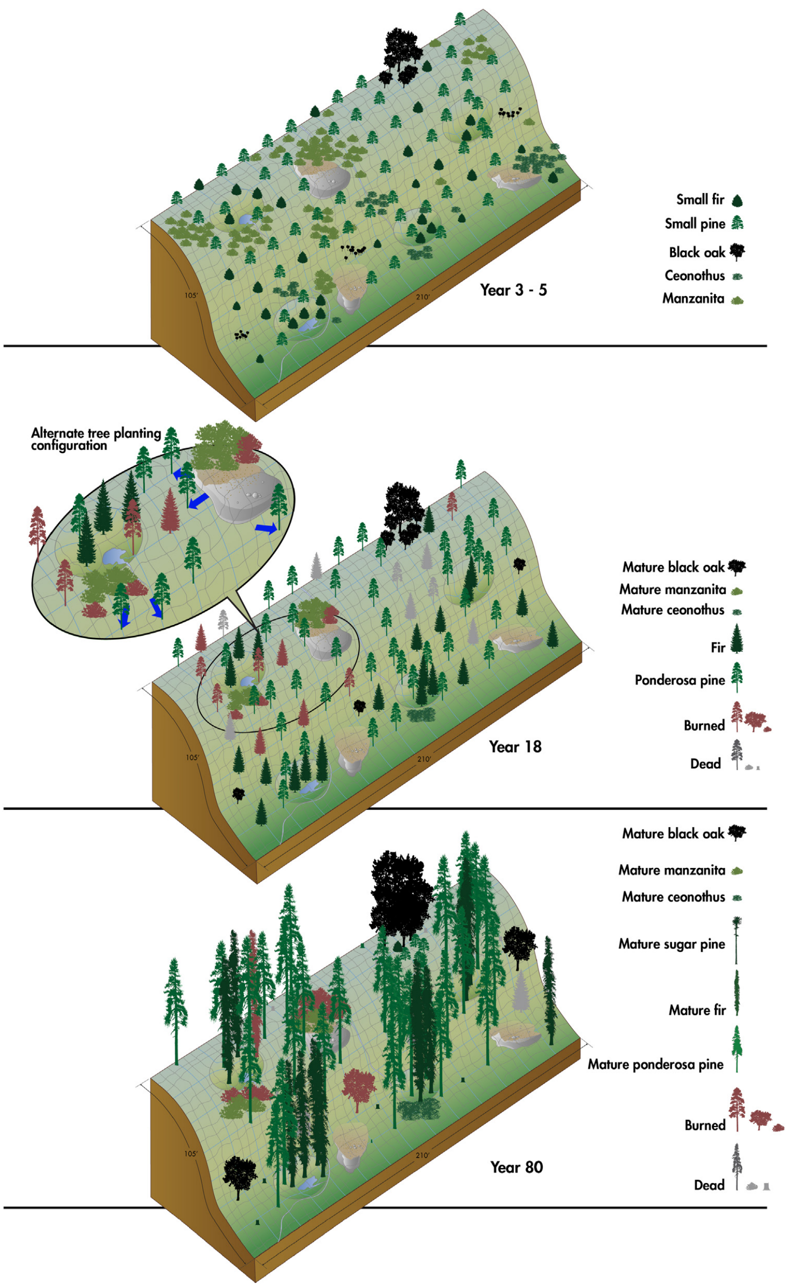
In reforestation areas created by a large-scale fire event, the authors propose a “three zone” approach (Fig. 2). In Zone 1, which consists of the burn zone found within the dispersal distance of live seed trees along the burn perimeter, planting efforts are minimal, serving only to complement natural recruitment from nearby seed sources. In Zone 2, planting follows the ICO approach and targets sites where microsite conditions may create localized refugia for seedlings. In Zone 3, which consists of remote, rough and/or steep terrain where reforestation would be both costly and produce low survivorship, planting is limited to strategically-located founder stands that will eventually reseed via dispersal.

Management Implications

- Reforestation efforts that emphasize planting arrays with a combination of scattered individuals, clusters, and open spaces may increase stand resilience to drought and fire.
- A 3-zone strategy for replanting burn areas may reduce costs and foster spatial heterogeneity by prioritizing core areas that are outside the dispersal range of seed trees but are still accessible and have favorable site conditions.

This combined approach takes into consideration that traditional high-density, regular-array reforestation efforts are: (1) more costly (important in an era of decreasing reforestation budgets); and (2) ill-suited to increasingly variable climatic patterns marked by drought and heat waves. The authors argue further that the traditional goal of reforestation – creating closed-canopy forest capable of producing an intermediate commercial harvest – may no longer be appropriate. Instead, we should adopt a longer-term goal of creating stands that resemble mature forests in structure and composition.

To achieve this goal, as well as stands with long-term ecological resilience, the authors recognize - but hope to limit - the need for periodic follow-up (e.g., thinning, mastication, prescribed fire). They recommend flexibility in target planting densities, seedling species composition, and the kind of spatial variability where clustered seedlings can outcompete shrubs in some areas, but where shrubs are allowed to proliferate in others. This approach may also benefit wildlife by creating varied habitat at the stand scale. Additionally, it may buffer against stand-replacing fires by breaking up crown continuity, generating variable surface fuel loads, and creating openings that serve as mini fire breaks.



When follow-up treatment is needed, greater use of low-intensity prescribed burns is proposed. While such burns produce more variable results than traditional mechanical treatments, they are also less costly and contribute to the type of spatial heterogeneity that fosters long-term resilience. That said, the authors recognize the need for more research on the effects of prescribed fire on regeneration, as well as improved understanding of the physiological responses of seedlings to a variable planting approach.

Fig 2. A partially salvaged area two years after the 2014 Eiler Fire near Burney, California. Zone 1, outlined in green, indicates areas likely to receive seed from adjacent islands of green trees. Zone 2, in the remaining area beyond most natural recruitment, are the areas readily accessible for reforestation. Two areas within this zone, A and B separated by the blue dashed line, indicate gentler, more uniform topography (A) and more variable, steeper sloped conditions (B), each of which could have a different planting strategy discussed in the text. The unsalvaged, snag area in the center could be planted if safety allows (facilitating future forest habitat connectivity) or left to provide wildlife habitat for post-fire specialists. Zone 3, outlined in red in the distant center of the photo, is a steep slope, distant from access roads that might be planted with founder stands (groups of seedlings in mesic, sheltered microsites less likely to burn or become drought stressed).

Fig 1. Schematic of the initial planting and stand development for a 0.2 ha (0.5 ac, 105 by 210 ft) slope of mixed-conifer forest. (A) Initial planting schematic (usually within 1–5 years following disturbance) where more mesic microsites (concavities in the figure) are identified and planted with clusters of trees and then the remaining area is planted with individual trees on a regularly spaced grid (here 4.6m or 15′ by 15). (B) After the first burn (15 years after planting). In this hypothetical example, some trees have died over the last period or were killed by the prescribed fire, reducing live tree density. (C) After 77 years of growth. Fire has been applied every 15 years to reduce fuels and shrub cover. Density has been reduced from 164 planted trees/ac to 86 trees/ac, within the estimated historical mixed conifer density (24–133 trees/ac) (Safford and Stevens, 2017).