Research Brief for Resource Managers

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Smart Practices and Architecture for Prescribed Fire in California (SPARx-Cal) - https://sites.uci.edu/sparxcal/

Adaptive Strategies for Managing Bishop pine with Fire

Bisbing, Sarah M., Alexandra K. Urza, Robert A. York, Lacey E. Hankin, and Tessa R. Putz. "Persistent, Viable Seedbank Buffers Serotinous Bishop Pine over a Broad Fire Return Interval." Fire Ecology 19, no. 1 (2023): 1-17. Accessed November 29, 2023. https://doi.org/10.1186/s42408-023-00194-3.

Management Implications

- Bishop pines can tolerate a wide range of fire return intervals (from 6-32+ years), but burning at an interval of 8 years or longer is necessary for sustaining a viable seed bank.
- Low-intensity prescribed fire can be explored to reduce fuel loads that develop from pine pitch canker infection and sapling die off as the stand ages and surface fuel loads increase.
- Management experiments documenting fire behavior and the effects of repeated prescribed burns have the potential to reveal a pyrosilvicultural strategy that initiates regeneration of Bishop pine while avoiding high severity fires that have negative impacts on built communities.

Background

Bishop pine (*Pinus muricata*), has serotinous cones and is a fire-obligate seeder (i.e., it cannot regenerate without fire) adapted to high-severity crown fires. Its natural range extends within coastal mountains from Santa Barbara County to Humboldt County in California, with some isolated populations in Baja California, Mexico. Bishop pine co-occurs in landscapes dominated by chaparral, which is adapted to a similar high-severity fire regime, and is common in high-risk wild urban interface (WUI) areas. Fire suppression in the WUI has dramatically altered the fire regimes now experienced by Bishop pine. This departure has resulted in increasing fuel loads and has lengthened fire return intervals. Restoring fire in a manner aligned with historic frequency and severity is difficult across all of California but is especially challenging where ecological restoration would logically include prescribed burning at high severity. Further, it is likely to be exponentially challenging to conduct high severity prescribed burns in WUI areas. Therefore, there is a particular need for studies that identify adaptive approaches that can regenerate Bishop pine with fire, while being pragmatic with respect to impacts on urban areas.

Seed Bank Management

Following a fire hot enough to open cones, young Bishop pine stands are extremely dense with regeneration. Via competition-related mortality, they quickly transition from high stand density with low individual cone production to lower stand density and higher individual cone production. This process increases surface fuel loads and builds up a seed bank within cones quickly. **A viable seed bank can develop within a very short time - 6 years after a fire - and remains viable for at least three decades.** To maximize seed bank viability, the authors recommend that managers should avoid

prescribed fires during the first decade after the establishment of a new cohort following hot prescribed fires or wildfires. Managers may then explore the use of low-severity prescribed fires to maintain lower surface fuels and promote lower stand density while still opening cones. Surrogates for prescribed fire (i.e., mechanical treatments) may also be feasible if they reduce surface fuels, but eventually fire will be necessary to promote regeneration.

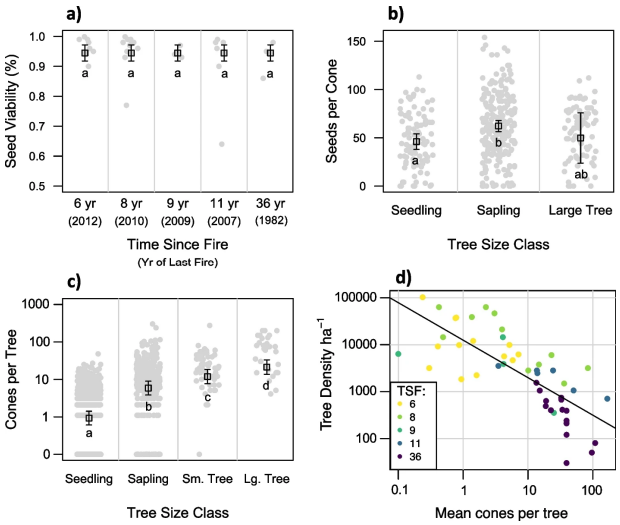

Figure 1: The effects of time since fire and tree size classes on the seed viability, seeds per cone, cones per tree, and tree density per hectare. **a)** Bishop pine seed banks become viable 6 years following fire and remain viable for multiple decades. **c**) Individual cone production is greatest in large trees. **d)** Individual cone production appears to be greater in low density stands.

Mitigating Pine Pitch Canker Infection

Pine pitch canker, caused by the non-native pathogen *Fusarium circinatum*, is most severe in the sapling phase, defined by the authors as 8-10 years post-fire. This pathogen can alter stand development by increasing mortality rates of sapling and intermediate sized trees. It also impacts fuel dynamics, causing more rapid build-up of fuels and potentially increasing the risk of high-severity fires in infected stands and potentially impacting WUI areas. This study suggests that prescribed fires conducted shortly after the seed bank has been established (~8-10 years) may mitigate the rapid buildup of fuels associated with pine pitch canker. Trials and studies of how prescribed fire interacts with pine pitch canker may help reveal its potential role in mitigating the pathogen's effect on Bishop pine stands. The use of prescribed fire as a management strategy to mitigate pine pitch canker in Bishop pine stands has potential but requires further exploration via management experiments that use fire. Managers can test the use of low-severity prescribed fires to reduce fuel buildup resulting from pine pitch canker as well as inhibit the spread of this non-native pathogen. Monitoring of fire effects will be key.

Preserving Bishop Pine Populations

Given Bishop pine's fire-adapted nature and the challenge of allowing high-severity wildfires to burn near urban areas, prescribed fires may help to ensure their persistence. There are two potential prescriptions managers can utilize: (1) a high-severity burn of mature stands, which is often difficult to do because of logistics and liability, or (2) conducting multiple lower-severity burns at higher frequencies, relying on either an eventual fire that is "hot enough" or a wildfire to regenerate a new cohort. The second prescription could be more feasible but is also more of a management experiment to see if the natural variability in fire severity can promote the regeneration of Bishop pines.

Management experiments may be able to define a prescribed fire schedule that can maintain low fuel loads until either a wildfire occurs, or a hotter prescribed fire can be conducted. Monitoring the fire behavior (e.g., flame length and crown damage) of these prescribed fires may help determine the type of fire that is necessary to initiate regeneration. In this scenario of active burning, the low-intensity prescribed fires would mitigate fire hazards to communities for a decade or more. And eventually, a higher-intensity prescribed fire or wildfire would regenerate the stands.

Understanding Bishop pine's unique fire ecology, seed bank dynamics, and the impact pine pitch canker infection has on stands is crucial for effective management. By utilizing prescribed fires, managers can help reduce fuel loads and stand density, which is especially important for stands located in the WUI, and potentially promote the long-term health and resilience of Bishop pine populations.