



Research Brief for Resource Managers

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Changing Knobcone Pine Risks Across Time and Range

Reilly, M. J., V. J. Monleon, E. S. Jules, and R. J. Butz. 2019. Range-wide population structure and dynamics of a serotinous conifer, knobcone pine (*Pinus attenuata* L.), under an anthropogenically-altered disturbance regime. *Forest Ecology and Management* 441:182-191. <https://doi.org/10.1016/j.foreco.2019.03.017>

Knobcone pine (*Pinus attenuata*) is a serotinous species with dynamic population structure across its range. Populations include a myriad of tiny, disjunct pockets from southern California to Oregon, as well as large, pure stands in the southwestern Oregon Klamath Mountains. Not only is it found sprinkled across a broad latitudinal range, but the species also covers a wide elevational gradient (<300 m to >1700 m). It grows in different soil types (including serpentine) and in many different vegetation types (e.g., chaparral, mixed forest).

Such a wide range of suitable conditions for one species makes its current population status and local responses under climate and fire regime change of conservation interest. Previous research showed that some populations of knobcone pine were in a state of senescence and dieback where 20th century fire had been absent. Less is known about how the species is responding to recent increases in fire activity over the last thirty years. These researchers decided to analyze where knobcone pine had expanded or contracted across its range in relation to fire history, so that they could assess the relative degree of senescence risk or immaturity risk (aka Interval Squeeze).

Management Implications

- Knobcone populations are extremely dynamic, with losses, gains, extirpation and colonization occurring among different populations over ten years across its range.
- Some populations of knobcone pine have experienced “**Senescence Risk**” with individuals dying of old age without reproducing and those populations experiencing extirpation.
- There may be greater potential for “**Immaturity Risk**” in the future as large fires increase and the potential for individuals to die before they are able to reproduce increases. Populations within the 13% of the species’ range that burned in the large fires in 2018 are at risk if fire re-occurs too soon.
- Collecting and conserving local seed sources may be the best way to protect this species from these potential but uncertain risks.

In looking at the fire history, they found that a substantial area had not burned since 1925 and that much of the area that had burned was in a few large, relatively recent fires. Only 63% of the range had burned between 1925 and 2015, Almost two thirds of that area burned in the twenty years after 1984, most of which occurred in just three years in the heart of the Klamath Mountains (1987, 2002, and 2008). Outside of the

Klamath Mtns., relatively little fire activity occurred, with the exception of about 6% of the range, which experienced repeated fire between 1985 and 2015. However, only 0.25% of the range has experienced fire return intervals of less than 10 years, the approximate time it takes for knobcone pine to mature and begin producing cones.

Based on 75 Forest Inventory and Analysis (FIA) program plots (2001-2017), classified into five population structure types and remeasured twice over a ten-year period, these researchers found that 45 % of the populations were old-growth and mature types with a large component of dead knobcone pines. This is indicative of widespread senescence risk across the species' range. However, over the ten year period of the study, there was great change in the relative abundance of population types (Fig. 1). Most notably, the number of plots with only seedlings increased from 3% of plots to 16%, most of which were associated with colonization of new sites.

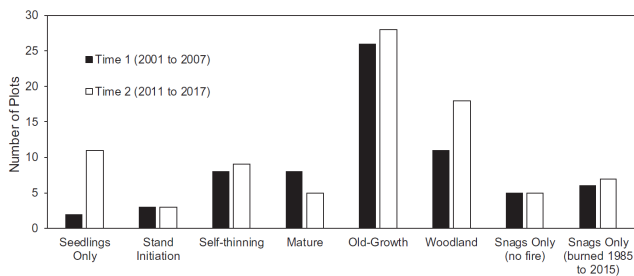


Fig. 1. Changes in the abundance of five knobcone pine (*Pinus attenuata*) population structural types over a ten-year period (2001–2007 and 2011–2017) from a systematically distributed sample across the range of the species.

Almost 30% of the 75 FIA plots had no change in the number of live trees over the 10-year period (Fig. 2, “Stable”). Almost twice as many plots experienced decreases in the number of trees than experienced gains. Local extirpations occurred in about 12% of plots with 8% occurring without fire and 4% with fire. Colonization occurred across almost 25% of the plots, indicating a cumulative range expansion that was roughly double the rate of extirpation.

Regardless of the measured population expansion, these researchers concluded that many existing

knobcone pine populations could be at risk of never reproducing before dying (i.e., senescence risk), especially outside of the recent Klamath Mountain fire footprints in the western Cascades of Oregon and portions of the eastern Cascades and Sierra Nevada of California that have not experienced recent fires. However, climate change could increase the potential for immaturity risk as fire affects more area in the future. In 2018, approximately 13% of knobcones' range was burned by large wildfires, including the devastating Mendocino Complex Fires (~450,000 acres) and the Carr Fire (~230,000 acres). Vulnerability to immaturity risk will be high in these areas for the next decade.

Knobcone pine populations were remarkably dynamic across their range over 10 years. The number of populations that gained individuals was roughly equal to those that were extirpated. Populations that lost individuals were roughly equal to new populations established by colonization, while only 30% of populations were stable (Figure 2). While risks are present, given its dynamic populations, predicting the future of the species as climate and fire regimes change is uncertain.

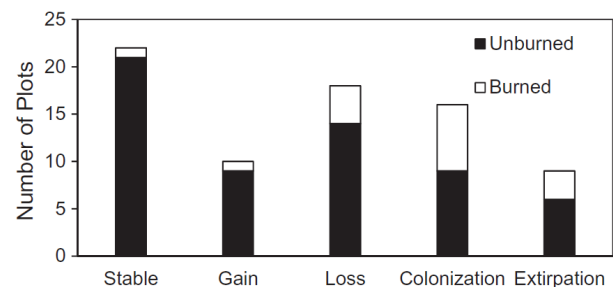


Fig. 2. Extirpation, colonization, and population trends of knobcone pine (*Pinus attenuate*) over a ten-year period (2001–2007 and 2011–2017) in seventy-five plots systematically distributed across the range of the species. Bars are color coded to indicate the occurrence of fire in a plot during the measurement interval with the exception of colonization, which includes whether or not a plot burned after 1984.