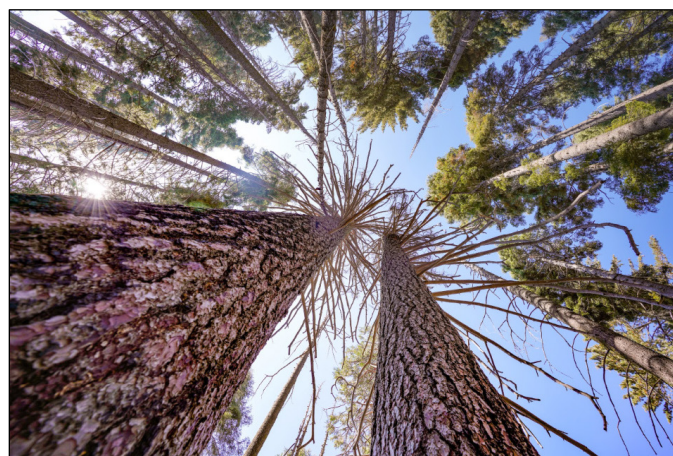




Sugar Pine Condition and Vulnerability in the Sierra Nevada: Evaluating the Drivers of Change

Key Findings:

- Sugar pine populations are declining throughout much of their range. Long-term datasets show consistent declines over the past 30–40 years (through 2019).
- Increased wildfire, white pine blister rust, and forest crowding are the greatest threats.
- Drought and site dryness add stress, especially during severe climate events.
- Young sugar pines are relatively rare, meaning that the species is struggling to replace itself.
- Management actions like conducting fuel treatments, careful prescribed burning, and planting white pine blister rust-resistant seedlings can help protect the species.



Dead sugar pines (at center) in Sequoia National Park. Photo credit: NPS/University of California, Berkeley/Joan Dudney

The Majestic Sugar Pine Faces Threats

Sugar pine (*Pinus lambertiana*) is the tallest and one of the most iconic pine species in western North America. It can reach 250 feet in height—about as tall as a 20-story commercial building. Sugar pines grow mostly in California and Oregon, where they are a key member of mixed-conifer forests. These trees provide food and habitat for wildlife, create important forest structure, and support healthy ecosystems.

However, sugar pine faces several serious threats, including altered fire regimes (historical fires were frequent and low intensity), an invasive fungal pathogen (white pine blister rust), bark beetles, changes in forest structure, and hotter droughts (combined effects of drought and heat). There has been concern for sugar pine in recent decades, and managers of national parks in the southern Sierra Nevada share the concern. At Sequoia & Kings Canyon National Parks, managers partnered with researchers at the University of California, Berkeley to document the status of the sugar pine across its range and identify the drivers of change.

The big question: *Are sugar pine populations stable, increasing, or decreasing—and why?*

How Did Researchers Study Sugar Pine?

To understand the condition of sugar pine, researchers used two main types of long-term forest data. They used data from the

U.S. Forest Service's Forest Inventory and Analysis (FIA) dataset to assess how stressors shape the survival, growth, and fecundity (the ability to produce abundant seeds) of the sugar pine across the majority of its range. They supplemented this regional assessment with site specific assessments at Sequoia National Park (NP), Yosemite NP, Baker Old-Growth Reserve, and Blodgett Forest (all in California). With these data, they studied long-term (>30 years) trends of sugar pine composition, structure, and population dynamics. Researchers also used models (integral projection models) to predict the effects of various stressors on the sugar pine population growth rate.

What Did Researchers Learn?

Regionwide Trends (FIA Dataset)

- Sugar pine tends to be a common but not dominant component of conifer forests where it occurs.
- Sugar pine abundance (stem density and basal area) decreased over the last decade (2011–2019).
- The most obvious declines in population density were in the southern Sierra Nevada. More northern regions of the Sierra Nevada saw an increase.
- Mortality exceeded recruitment of new trees.
- Based on modeling, the population growth rate is at or below stable levels.

National Park Trends

- 30+ years of data (~1983–2019) from Yosemite and Sequoia national parks show declines in sugar pine abundance.
- The relative dominance of sugar pine in the 19 study plots ranged from uncommon (<1%) to dominant (36% dominance).
- The relative dominance of sugar pine declined in every plot but one over the study period. Additionally, the relative decline of sugar pine was steeper than the overall decline in live-tree basal area.

What are the Major Stressors?

- **Altered fire regime.** Modern fires are more intense due to decades of fire suppression. Fire substantially reduced survival, especially for the smallest sugar pines. It also slows growth in survivors.
- **White pine blister rust.** This invasive disease increased mortality. Even mild infections can reduce survival chances.
- **High forest density.** Crowded forests (from 20th century fire exclusion) reduced sugar pine survival and, for small individuals, growth. Shade-tolerant species outcompete sugar pine in dense forests.
- **Site dryness & drought.** Long-term dryness had clearer effects on population dynamics than did drought (departure from average climate), with site dryness having an impact on growth of the largest and smallest trees. Drought also weakens trees, making them more vulnerable to bark beetles.

Extra Concern for the Largest Trees

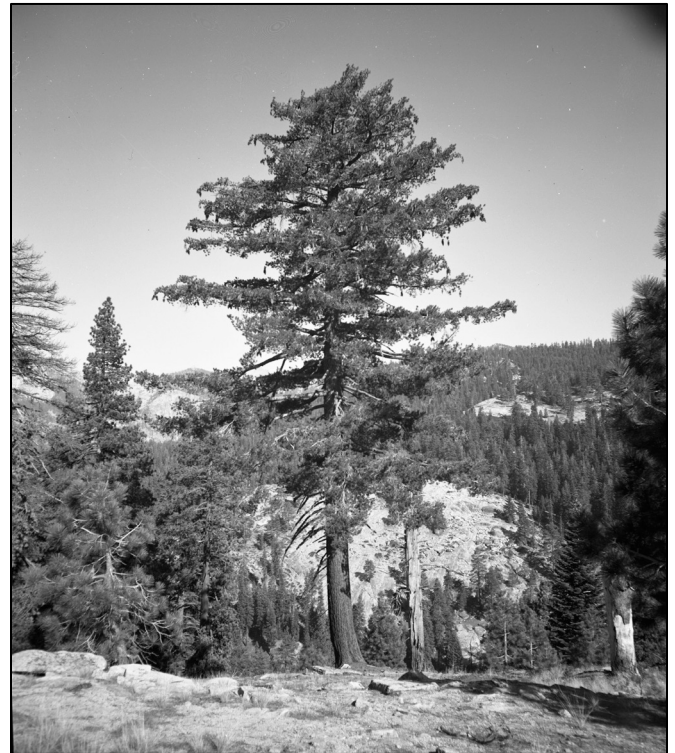
Researchers also found declining survival rates for the largest sugar pines. It's not clear why, but one possible explanation is bark beetles, which often prefer large trees once an outbreak is underway. These trees are an important ecological resource, so further research is needed.

How Can We Help Sugar Pine?

Management actions that could help stabilize declining sugar pine populations and protect forest ecosystems include:

- **Consider fuel treatments:** Study findings suggest that fuel treatments that include a reduction in density could benefit sugar pine populations.
- **Use prescribed fire carefully:** Apply low-severity burns; protect large, old sugar pines; and reduce fuels to prevent catastrophic wildfires.
- **Plant white pine blister rust-resistant seedlings:** Planting resistant seedlings during restoration efforts after high-severity burns would help restore sugar pine in impacted areas.

- **Conserve large trees:** Large trees are the strongest seed producers, and they provide structural and other ecological benefits.



A sugar pine (center) in a mixed-conifer community, Sequoia National Park, 1950s. Photo credit: NPS/Jack Hickey

This Brief is Based on:

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For More Information on Sugar Pine

- See this web article on [sugar pine at Yosemite National Park](#), published in September 2025.
- Read this [Featured Creature fact sheet on sugar pine](#), published by the NPS Klamath Inventory & Monitoring Network in 2021.
- Browse this NPS web article and 2020 publication focused on four [white pine species](#), including sugar pine.