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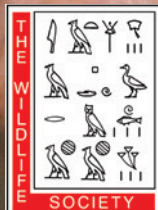
**Using dragonfly  
larvae as biosentinels  
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**Yellowstone is 150  
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# A Giant Loss

## LOSING SEQUOIAS COULD BE A BLOW TO SIERRA NEVADA BIRDS

By Rodney B. Siegel and Robert L. Wilkerson

Credit: Tony Caprio/NPS

▲ Part of the Homer's Nose giant sequoia grove in Sequoia National Park that burned in the 2020 Castle Fire.

**G**iant sequoias are the most massive trees on Earth. The largest grow taller than 80 meters, with a maximum diameter of over 11 meters at the base. But the trees' distribution, at least since the last ice age, is not commensurate with their size.

Today, giant sequoias (*Sequoiadendron giganteum*) occur naturally in about 70 scattered groves on the western slope of California's Sierra Nevada. This limited distribution—in a region experiencing unprecedented fire behavior—is proving perilous. The past two fire seasons have claimed an estimated 13-20% of all the world's large giant sequoias (Shive et al. 2021).

The problem is not that giant sequoias are poorly adapted to fire. Mature trees have thick, fire-resistant bark, and they generally lack branches close to the ground where fire could most easily reach the more flammable foliage. These adaptations have allowed the trees to coexist with fire for millennia. Indeed, giant sequoias depend largely on fire for reproduction. Flames dry out tightly sealed cones, allowing them to release their seeds.

Rather, the issue is that climate and forest structure have changed, and because fire behavior depends on both, it has changed, too. A century of fire suppression and a warming climate have left Sierra Nevada forests with dense understories, continuous canopies and a large accumulation of dead wood on the forest floor, all of which foster high-intensity fire. Extremely hot fire can render the sequoias' natural defenses insufficient

and is increasingly calling into question the species' long-term persistence in the wild.

Conservationists and the public at large are rightly concerned about the loss of giant sequoias in their own right. The trees are beautiful, ancient and awe-inspiring. But wildlife habitat—especially habitat for birds—is also at stake.

Sequoias add enormous structural complexity to the mixed conifer forests they tower over, greatly increasing foraging and nesting substrate available to birds. Our organization, The Institute for Bird Populations, has partnered with the National Park Service to survey birds in Sequoia and Kings Canyon national parks—where many of the flagship groves and the largest giant sequoias in the world occur—nearly every summer for over two decades. We are struck again and again by how many birds we detect in and among the towering sequoias.

Giant sequoia groves are the 'birdiest' forests in these parks. We estimated densities of the 77 most commonly detected bird species in each of 28 plant communities across the parks (Siegel and Wilkerson 2005). That includes grasslands, shrublands and forest types ranging from lower-elevation ponderosa pine (*Pinus ponderosa*) to subalpine conifer near the Sierra Crest.

In most forest types, only one or two bird species reached their highest observed density. Other than giant sequoia groves, the forest type with the most bird species at maximum observed density was





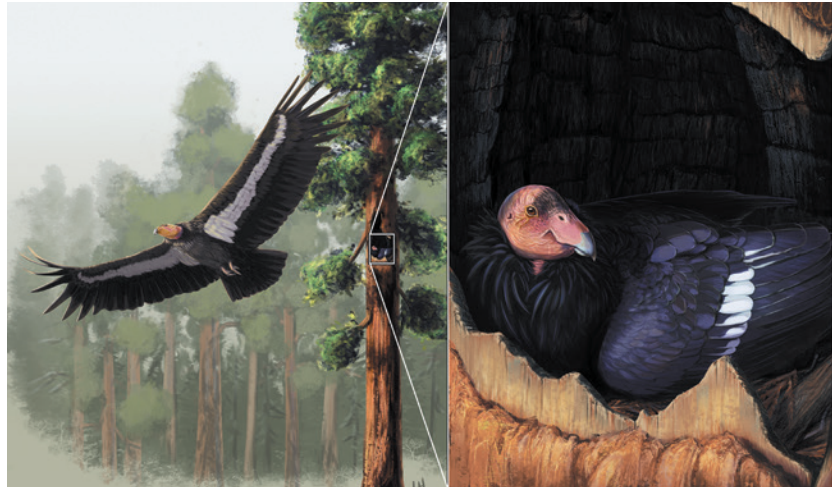
western white pine woodland, with six such species. In contrast, 12 bird species reached their highest observed density in giant sequoia groves, twice the number in any other montane forest type.

These species are taxonomically and functionally diverse. They include multiple species of woodpeckers, resident species like red-breasted nuthatches (*Sitta canadensis*) and neotropical migrants like western tanagers (*Piranga ludoviciana*), hermit warblers (*Setophaga occidentalis*) and Pacific-slope flycatchers (*Empidonax difficilis*). White-headed woodpeckers (*Picoides albolarvatus*) and Pacific wrens (*Troglodytes pacificus*) occurred at twice the density in giant sequoia groves as in any other forest type in the parks. Golden-crowned kinglets (*Regulus satrapa*) were the most abundant of all bird species in giant sequoia groves. Watching them busily defend their small, densely packed territories among the enormous trees is one of the unmistakable delights of visiting the groves during summer.

The persistence of these sequoia-loving bird species in the Sierra Nevada is not directly dependent on giant sequoias. None of them are obligately tied to the trees. But the loss of sequoias is surely diminishing their populations, yielding yet another cumulative threat among many others that have led to pervasive reductions in bird populations across North America during the past 50 years (Rosenberg et al. 2019).

One species, however, may be tied obligately to giant sequoias for nesting in portions of the Sierra Nevada—the California condor (*Gymnogyps californianus*). The largest of North America's land birds, condors nearly went extinct in the 20<sup>th</sup> century, but populations are now rebounding due to amelioration of some of the factors that caused their decline—such as the widespread use of DDT—combined with ambitious captive breeding and reintroduction efforts.

Although condors typically nest in caves and ledges on cliff walls, they also historically nested in the burned-out cavities of fire-scarred (but typically living) giant sequoias (Snyder et al. 1986). Condors have been extirpated from the Sierra Nevada as a breeding species for nearly four decades, but far-ranging individuals have been observed visiting the southern Sierra Nevada on multiple occasions in recent years, suggesting the possibility of recolonization and highlighting the importance of maintaining the unique structural attributes of giant sequoias if the birds are ever to nest again in Sierra Nevada forests.



Credit: Lauren Helton, The Institute for Bird Populations

Some people argue that because giant sequoias are fire adapted, interventions to protect them from burning in wildfires are misguided or even counter-productive. They argue that these measures—such as using prescribed fire or mechanical means to thin forests under and around the trees, buffering groves with firebreaks, or even protecting individual trees with sprinklers or fire-resistant wrapping when active fire poses a direct threat—reflect a fundamental misunderstanding of the important role of fire in Sierra Nevada ecosystems.

As scientists who have been studying avian responses to fire in the Sierra Nevada for 15 years and have published findings confirming the value of fire for Sierra Nevada birds (e.g., Tingley et al. 2016), we agree on the desirability of fire regimes closer to what occurred prior to the suppression era, when fire was frequent but typically lower severity and seldom yielded the enormous patches of high-severity, stand-replacing fire we increasingly see now.

But fire that kills large numbers of ancient giant sequoias was not a regular part of the pre-suppression fire regime. In destroying mature giant sequoias, recent blazes have consumed forest structure that will require hundreds of years to regenerate—if sequoia regeneration is even possible under current and future climatic conditions. This accelerating pattern of loss will diminish habitat quality for birds and likely other wildlife.

Concerns about giant sequoia loss are much broader than sentimental attachment to individual trees. Important habitat for birds and other wildlife is also at stake. Land managers should factor that into decision-making about interventions that may be warranted to try to sustain giant sequoias as a functional part of Sierra Nevada ecosystems. ■

▲ California condors formerly nested in giant sequoias and could again someday as their population rebounds, if the enormous trees persist.



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