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# Yosemite's Merced Grove of giant sequoias: critical restoration continues despite legal challenges

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## Abstract

**Background** Giant sequoias are the most massive individual trees on earth, and among the longest-lived. They also have a limited distribution, covering ~10,000 ha across ~70 distinct groves. Severe wildfires in 2020 and 2021 impacted 82% of the range, killing roughly 13–19% of the entire population of these irreplaceable trees. Within the giant sequoia range, the Merced Grove is one of the most at risk of burning at high severity. Located in Yosemite National Park, it has no recorded wildfire history and has received minimal restoration treatment, most of which occurred decades ago. From 2008 to 2018, six wildfires burned towards the grove, but were stopped by aggressive fire suppression and favorable weather conditions. The grove is in complex terrain, adjacent to the park's boundary, and surrounded by long-unburned mixed-conifer forests, which has challenged the park's attempts to implement prescribed fire for decades. Park managers determined that restoration thinning could help reduce prescribed fire implementation complexity and increase forest resilience to drought and wildfire and began implementation in 2022. Litigation attempted to halt this work. Among the plaintiff's claims were that the park did not follow appropriate procedures during their environmental impact analysis as required under the National Environmental Policy Act (NEPA), and that there was considerable scientific controversy around mechanical thinning.

**Results** The U.S. District Court ruled in favor of Yosemite National Park, finding that they followed appropriate NEPA procedure and that the plaintiffs failed to prove that the work was "highly controversial." On appeal, the U.S. Ninth Circuit Court affirmed the District Court's decision, noting that the plaintiffs had mischaracterized the project and the relevant science.

**Conclusions** From high-value sequoia groves that are relatively rare on the landscape, to the extensive frequent fire forests across the western U.S., fire's return is inevitable. There is strong evidence that active management, such as thinning and prescribed fire treatments to reduce fuels, can create forests that are more resilient to wildfire and other stressors. This restoration project and its associated court case demonstrate that when agencies follow the appropriate procedures for their circumstances, plan projects based on the best available science, and use that science to defend their work, they can prevail in the face of litigation. With the staggering losses of large, ancient giant sequoias to severe wildfires in recent years, this restoration work is both urgent and essential.

**Keywords** Mixed-conifer forests, Forest restoration, Agenda-driven science, Litigation, Giant sequoia

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## Resumen

**Antecedentes** Las sequoías gigantes son de los árboles más grandes del mundo y entre los más longevos. También tienen una distribución limitada cubriendo aproximadamente 10.000 ha en ~70 bosques distintos. Incendios forestales severos en 2020 y 2021 impactaron el 82% de su distribución ecológica y mataron aproximadamente 13-19% de la población total de estos árboles únicos. Dentro de su rango ecológico, el bosque Merced es uno de los que tienen el riesgo más alto de incendio de alta severidad. Ubicado en el Parque Nacional Yosemite, no tiene registrada una historia de fuego y ha recibido tratamientos mínimos de restauración, muchos de los cuales ocurrieron muchas décadas atrás. De 2008 a 2018, seis incendios ocurrieron en dirección hacia ese bosque, aunque fueron detenidos mediante la supresión de incendios agresiva acompañada de condiciones meteorológicas favorables. Este bosque está situado en un terreno complejo, adyacente a los límites del parque y rodeado por bosques mixtos de coníferas que no han sufrido incendios por muchos años, lo que ha motivado los intentos de los gestores del parque para implementar quemas prescriptivas. Los gestores del parque determinaron que la poda mecánica restaurativa podría ayudar a reducir la complejidad que presentan los incendios prescriptivos e incrementar la resiliencia del bosque frente a las sequías e incendios y comenzaron su implementación en 2022. Litigación intentó frenar este trabajo de poda mecánica. Los litigantes discutieron que el parque no había seguido procedimientos adecuados para su análisis del impacto ambiental requerido bajo la Ley de Políticas Ambientales Nacionales de los EE. UU. (NEPA), y que existía considerable controversia científica sobre los tratamientos de poda mecánica y quemas prescriptas.

**Resultados** La Corte de Distrito de los EEUU resolvió a favor del Parque Nacional de Yosemite, argumentando que el Parque había seguido los procedimientos apropiados establecidos en la NEPA, y que los litigantes no pudieron comprobar que el trabajo realizado era “altamente controversial”. Luego de apelar, la Corte del Noveno Distrito de los EEUU reafirmó la decisión de la Corte del Distrito, haciendo notar que los litigantes caracterizaron erróneamente tanto el proyecto como la ciencia relevante para este caso.

**Conclusiones** Desde el alto valor de los bosques de sequoia, que son relativamente escasos en el paisaje, hasta los extensivos y frecuentes incendios a lo largo del oeste de los EE. UU., el retorno de fuego al ecosistema es inevitable. Es aquí donde hay una amplia evidencia que demuestra que el manejo activo, tal como lo son los raleos y las quemas prescriptas para reducir la cantidad de combustible, puede crear bosques que sean más resilientes a los incendios y a otros factores de estrés ecológico. Este proyecto de restauración y su asociado caso judicial, demuestran que cuando las agencias siguen procedimientos apropiados, los proyectos se basan en la mejor ciencia disponible, y se utiliza la ciencia para defender el trabajo, pueden prevalecer en el caso de litigio. Con la pérdida mayor de sequoías gigantes por incendios forestales severos en los últimos años, este trabajo de restauración es tanto urgente como esencial.

## Introduction

Increases in wildfire activity in recent decades are impacting communities and ecosystems around the globe. In historically frequent-fire forests of the western U.S., high-severity fire is occurring in extents that are well outside of the historical range of variability for these ecosystems (Steel et al. 2018; Williams et al. 2023), with increasingly negative impacts on human communities (Knapp et al. 2021), infrastructure (Fraser et al. 2022), watershed function (Belongia et al. 2023), maintenance of forest cover (Steel et al. 2023), and sensitive wildlife species (Jones et al. 2016; Steel et al. 2023). The increase in high-severity fire in these forest types has been attributed to a combination of the buildup of woody fuels, increased tree density after over a century of fire exclusion (Collins et al. 2011; Parsons and DeBenedetti 1979), and a warming and drying climate (Parks and Abatzoglou 2020).

In terms of ecological impacts, giant sequoias (*Sequoiadendron giganteum* (Lindl.) J. Buchholz) are emblematic of the issues facing historically frequent-fire forests

across the West. Giant sequoias are the most massive individual trees on earth, with lifespans that can exceed 3000 years (Hartesveldt et al. 1975). The trees are found in approximately 70 populations (“groves”) covering ~10,000 ha on the western slope of California’s Sierra Nevada range (Hart 2023). Giant sequoias are the quintessential fire-adapted species, with bark that can be over 60 cm thick (Hartesveldt et al. 1975), semi-serotinous cones (Hartesveldt et al. 1969), and a multi-millennial fire history wherein fires burned roughly every ten years before fire suppression (Swetnam 1993; Swetnam et al. 2009). These iconic trees have long been valued by Indigenous people, who stewarded these landscapes with fire, which now attract visitors from across the globe (Tweed 2015). However, over 125 years of fire exclusion have led to significant increases in tree density and woody fuel buildup. When coupled with a warming climate, these conditions have resulted in roughly 1800 ha burning at high severity since 2015 (Shive et al. 2021; Stephenson and Brigham 2021), in patch sizes that are well outside



**Fig. 1** Mature giant sequoias killed in the 2021 KNP Complex wildfire in Redwood Mountain Grove. The photo was taken one year postfire (photo courtesy of Marc D. Meyer)

the historical range of variability (Stephenson et al. 2024). As a result, an estimated 13–19% of the world's ancient giant sequoias were lost in the 2020 and 2021 fire seasons alone (Shive et al. 2021; Stephenson and Brigham 2021; Fig. 1). These fires have raised the alarm on the need to protect this highly valued species. Because the growth of these ancient trees can take millennia, they are effectively irreplaceable within human timescales. Moreover, where these individuals were killed in crown fires, regeneration has been limited, raising concerns about the persistence of the species in its native range (Soderberg et al. 2024).

To avoid these unprecedented losses, forest managers across the giant sequoia range are working to increase the pace and scale of forest restoration treatments (National Park Service 2022; US Forest Service 2022). There is widespread agreement among scientists and managers that restoration treatments that reduce woody surface fuels and tree densities can substantially reduce the potential for high severity fire in historically frequent-fire forests like giant sequoia (Hagmann et al. 2021; Prichard et al. 2021; Stephens et al. 2021a, 2024; Davis et al. 2024). These forest restoration treatments include mechanical

treatments and prescribed fire, both of which can reduce fire severity and create safer conditions for fire managers to either stop or manage a wildfire (Brodie et al. 2024; Davis et al. 2024; Kalies and Yocom Kent 2016; Shive et al. 2024; Tubbesing et al. 2019; Stephens et al. 2024). The combination of thinning and prescribed fire is generally the most effective at reducing fire severity, since it reduces both surface and ladder fuels (Davis et al. 2024).

#### **Merced Grove**

The Merced Grove is a relatively small sequoia grove, covering just 6.4 ha (Hart 2023) at 1675 m in elevation in the Big Oak Flat area of Yosemite National Park (hereafter: “the park”). Moss Creek flows through the grove and supports a small wetland near its southern end. The grove was initially surveyed in 1930 (Bellue 1930); these early observations describe abundant young adult trees in open, sunny areas but few seedlings, which were attributed to fire exclusion and cattle grazing (Bellue 1930). A 2014 survey also found poor giant sequoia recruitment likely due to the absence of recent fire and a lack of canopy gaps that enable further

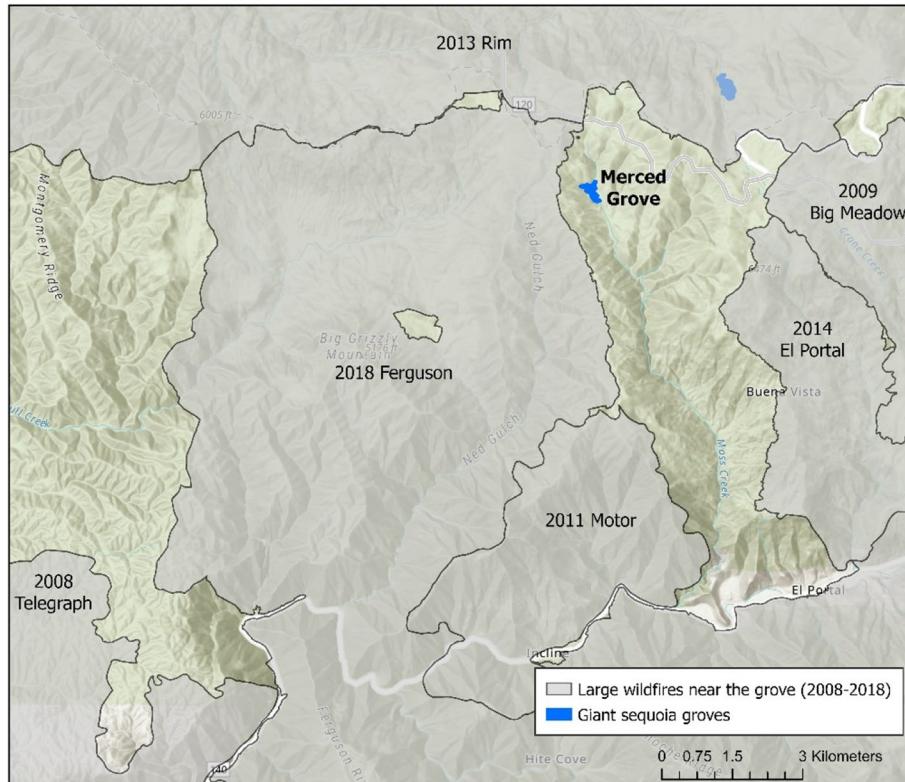
**Table 1** Demography of giant sequoias in two of the three giant sequoia groves in Yosemite National Park, by size class (Kuhn 2014). Note that Mariposa Grove has been repeatedly prescribed burned since 1971

Size class (DBH (cm))	Mariposa	Merced
Large adult (> 200)	466	32
Small adult (100–200)	16	16
Juvenile (20–100)	495	71
Sapling (2–20)	203	56
Seedling (< 2)	3084 (estimate)	15
Total live trees	4264 (estimate)	190

giant sequoia establishment (Kuhn 2014). Owing to great shade intolerance, the sapling to juvenile classes were highly suppressed due to a lack of overhead sunlight in the near-continuous canopy of the forest. In contrast, the nearby Mariposa Grove, also in the park, has an order of magnitude more giant sequoia regeneration (Table 1) because it has a long history of restoration activities that included restoration thinning and ongoing prescribed fires since 1971 (Hankin et al. 2023).

For over 125 years, wildfire has been excluded from a 1200-ha area surrounding the Merced Grove, and only three small prescribed fires have occurred in and adjacent to the grove. The year and hectares prescribed burned inside the grove boundary are: 2.1 ha in 1976, 3.1 ha in 1977, and 0.3 ha in 1990. While each of these burns included some area that was adjacent to the grove, the largest was still only 17 ha in 1977. Limited thinning of small trees also occurred in the upper end of the grove near the roadway in the early 2000s. As a result of halting customary Indigenous burning, suppressing lightning-caused surface fires, and minimal restorative thinning and burning projects, the grove had exceptionally high fuel loads and tree densities, putting it at high risk of severe fire.

Between 2008 and 2018, six wildfires threatened the grove but were suppressed before the fire reached it. Subsequently, the area surrounding Merced Grove has the highest concentration of bulldozer lines in the park (National Park Service, n.d.). As a result, the Merced Grove has thus far been spared from high-severity fires, but not without luck, moments of favorable fire weather and intensive firefighting (Fig. 2). During the 2013 Rim Fire, firefighters stopped the fire on the ridge above



**Fig. 2** The Merced Grove with wildfire perimeters that have threatened the grove in recent years. Note that Tuolumne Grove is also visible to the northeast. The Tuolumne Grove area had a richer prescribed fire history prior to the 2013 Rim Fire, which helped facilitate a backburn as the wildfire approached, resulting in overall positive fire effects



**Fig. 3** Repeat photos in Merced Grove: before and immediately after restoration thinning. The grove will soon be ready for pile burning and then prescribed fire. (NPS photo)

the grove. The 2014 El Portal Fire again threatened the grove, but it was also contained in time. In 2018, the Ferguson Fire threatened to enter the grove from the Merced River canyon below, and firefighters frantically removed surface fuels from around the bases of the giant sequoia trees and even set up sprinkler systems to moisten surface fuels. Firefighters benefited from a break in the weather, which allowed them to keep the fire out of the grove.

The changing climate is also playing a powerful role in increasing the risk of severe fire. Climate and weather patterns have already changed at the Merced Grove (National Park Service, n.d.) and elsewhere in California (Hayhoe et al. 2004). Since 1979, the average annual temperature has increased by 0.8 °C, and vapor pressure deficit is on the rise (Williams et al. 2019). Projected increases in temperatures and vapor pressure deficits will further contribute to a larger burned area and more severely burned area (Bedsworth et al. 2018). Data from a Remote Automated Weather Station (<https://raws.dri.edu/cgi-bin/rawMAIN.pl?caCCRA>), located to the north and roughly 210 m higher than the grove, documents that from 1992 to 2024 there was an average of 5 days above 30 °C (with a maximum of 22 days in 2002). By 2040, multiple emissions scenarios and climate models predict that much of the fire season exceeds this threshold (caladapt.com).

Precipitation in this area has been highly variable, ranging from extremely wet years to the recent “hotter drought” of 2012–2016. The drought caused widespread tree mortality in the central and southern Sierra Nevada (Fettig et al. 2019), including areas within the Grove, which has been linked to increasing woody surface fuel inputs (Northrop et al. 2024). High levels of woody

debris on the forest floor increase the likelihood of severe fire behavior (Stephens et al. 2022). Hotter droughts have also already resulted in water stress on giant sequoias (Diffenbaugh et al. 2015; Stephenson et al. 2018), an occurrence likely to reoccur given predictions for continuing fluctuations of very wet and very dry periods (Swain et al., 2023).

#### Grove restoration

Given the National Park Service’s (NPS) mandate to protect critical resources, the widespread impacts of recent wildfires on giant sequoias in the southern Sierra Nevada (Shive et al. 2021; Stephenson and Brigham 2021), coupled with the conditions in Merced Grove, spurred the park to action. The NPS enabling statute, the Organic Act (National Park Service Organic Act, 2014) calls for managing national parks in a way that leaves them “unimpaired” for future generations, which fundamentally requires protection of irreplaceable natural features. This obligation is explicitly addressed in the park’s Fire Management Plan Environmental Impact Statement (FMP; National Park Service, 2004), which included an analysis of the condition of all three of the park’s sequoia groves and concluded that without treatment, impairment was likely. In addition, the park’s enabling legislation (U.S. Statutes at Large 1864) specifically recognizes the protection of giant sequoias as central to the park’s purpose.

To address the threat to Merced Grove, park managers designed a restoration project to reduce ladder fuels between the ancient trees by removing live and dead non-sequoia conifers  $< 50$  cm diameter at breast height (DBH). The prescription included restoration thinning ((where some of the material was sold to recover restoration costs, and some were transported off site to benefit a

meadow restoration project in the park), slash pile building (Fig. 3), followed by pile burning and a subsequent broadcast burn. In addition to the grove itself, thinning was planned along road corridors and near communities.

Collectively, these projects had two primary goals. First, the thinning in the Merced Grove was intended to reduce prescribed fire implementation complexity, increase restoration treatment effectiveness (Davis et al. 2024), build forest resilience, and promote sequoia regeneration (Meyer and Safford 2011; Stephenson 1999). Second, reducing fuel and hazardous trees along the major ingress/egress routes in the park was intended to promote firefighter safety and increase the ability of firefighters to engage a fire and protect communities. After severe wildfires and the 2012–2015 drought, there were substantial heavy fuel loads along the road corridors in the park that made them unsafe and unreliable as fire control and containment features. If unwanted fire came from outside of the park, improved roadside conditions could improve the ability for firefighters to safely engage and stop a fire. Conversely, if there was a fire that was burning under appropriate conditions and doing good ecological work (e.g., reducing fuel loads and tree density, restoring fire as an ecological process) in more remote areas, firefighters could manage the wildfire for resource benefit, using these roads as containment lines. The park has an exceptional history of managing wildfires for resource benefit where conditions allow (Boisramé et al. 2017; van Wagtendonk and Lutz 2007; van Wagtendonk et al. 2012; Stephens et al. 2021b), but the untreated condition of the road corridors was limited the extent to which they could use restorative, managed wildfire in those areas in recent years (Kelly Singer, Deputy Fire Management Officer, Yosemite National Park, personal communication, 2024).

#### NEPA compliance

Because these treatments are occurring on federal land, they are subject to the National Environmental Policy Act (1969; NEPA), as well as other applicable regulations designed to protect critical resources (e.g., the Endangered Species Act 1973). NEPA requires agencies to analyze potential environmental effects of proposed major federal actions (and inactions), consider reasonable management alternatives, and involve the public. When the potential for significant impacts is uncertain, agencies typically prepare an Environmental Assessment (EA). If significant effects are likely, they prepare a detailed Environmental Impact Statement (EIS).

For actions where significant impacts are unlikely, a Categorical Exclusion (CE) may be used. There are different types of CEs approved for use in the U.S. Department of the Interior (the US Department in which the NPS is

housed). In the case of the project under discussion, the NPS used CE number 3.3.B.1, which covers “changes or amendments to an approved plan when such changes would cause no or only minimal environmental impact.” The park determined that the CE applied to the restoration projects because the proposed treatments had been analyzed in the FMP and the changes from the FMP would cause no or only minimal environmental impacts. The park’s FMP is both programmatic and site-specific, and subsequent actions that fit within its analyses are to be tiered and documented with a CE where appropriate.

#### Legal proceedings

While the public at large is increasingly supportive of forest management treatments to restore fire resilience (McCaffrey and Olsen 2012), a few individuals and organizations oppose active management, resulting in litigation. In some cases, of course, the agency may not have done its due diligence and there is merit to the case. However, in other cases, the litigants may simply oppose active forest management and employ procedural arguments, and/or point to cherry-picked science and contested studies to try to stop the work in court (Peery et al. 2019a).

A recent lawsuit against Yosemite National Park provides a critical example of the role that the best available science can play in such lawsuits, with takeaways for both scientists and managers. Here, we provide a brief overview of the court case, highlighting evidence of how the plaintiffs selectively referenced and mischaracterized both the literature and the projects, tactics that have been associated with agenda-driven science (Peery et al. 2019a, 2019b; Jones et al. 2022).

#### The lawsuit

In 2022, Earth Island Institute (EII) filed a lawsuit against the NPS in the U.S. District Court for the Eastern District of California to halt implementation of the fuel reduction projects described above. (For clarity and neutrality, the Earth Island Institute and its declarants are referred to hereafter collectively as “the plaintiffs”; details on individual contributors can be found in the original court documents). The plaintiffs also sought a preliminary injunction – a court order that would temporarily stop the work while the case proceeded. Although the plaintiffs invoked a number of objections, their fundamental arguments rested on the use of a CE. They claimed a CE was inappropriate for numerous reasons that can be found in the court documents, specifically in the plaintiffs’ amended complaint (*EII vs. Muldoon*, Case No.: 1:22-cv-00710-AWI-EPG, Dkt. No. 21 (E.D. Cal. 2022)). For the purposes of this review, our interest is in the plaintiffs’ claim that “extraordinary circumstances” prohibited the use of a CE.

At the time of the litigation, the relevant regulations stated: “If an agency determines that a categorical exclusion identified in its agency NEPA procedures covers a proposed action, the agency shall evaluate the action for *extraordinary circumstances* in which a normally excluded action may have a significant effect.” The Department of the Interior (DOI) has identified a range of conditions that could potentially create extraordinary circumstances, of which the plaintiffs focused on two: (1) the presence of an Endangered Species Act (Endangered Species Act, 1973) listed species (in this case, the Pacific fisher (*Pekania pennanti*), California red-legged frog (*Rana draytonii*), and California spotted owl (*Strix occidentalis occidentalis*), which was not yet listed but was proposed for listing at the time of the litigation), and (2) where the proposed actions have “...highly controversial environmental effects or involve unresolved conflicts concerning alternative uses of available resources (43 C.F.R. § 46.215(c))” (*EII vs. Muldoon*, Case 1:22-cv-00710-AWI-EPG, Dkt. No. 71 (E.D. Cal. 2022)). The plaintiffs argued that thinning to reduce fire risk is highly controversial, and that the NPS failed to acknowledge more recent scientific publications since the FMP was drafted, which they claimed made the 2004 FMP outdated.

In response, the NPS argued that there was precedent for how it used the CE, that these activities were critical for life and safety, and habitat protection, and that activities were well in line with their existing FMP and other relevant NEPA documents. For the claim of extraordinary circumstances around endangered species, the NPS argued that its engagement with subject matter experts and FWS consultation was sufficient in determining that their proposed action would not have significant adverse impacts on endangered species, and that the projects would likely benefit the Pacific fisher. The NPS also argued that there were no highly controversial environmental effects, because the projects were well in line with existing science. To support these assertions, the park relied on detailed declarations, which included those written by park staff as well as outside experts. These declarations affirmed that the proposed treatments were based on the best available science, consistent with past planning efforts, and that there was a low likelihood of causing significant environmental harm. They also directly addressed the use of contested and problematic peer-reviewed publications that were presented by the plaintiffs.

#### ***The court rulings***

To obtain a preliminary injunction, plaintiffs must establish: (1) that they are likely to succeed on the merits of the case (as the court noted, this requirement carries a

relatively low bar, i.e., plaintiffs must simply show that the merits are not obviously deficient), (2) they are likely to suffer irreparable harm in the absence of the injunction, (3) that the balance of equities tips in the plaintiffs’ favor (i.e., the potential hardship to the plaintiffs is greater than the potential hardship to the NPS), and (4) that an injunction is in the public interest (criteria established in the Supreme Court decision: *Winter vs. Natural Resources Defense Council, Inc.*, 555 U.S. 7, 20 (2008)).

The District Court denied the preliminary injunction in 2022. In evaluating the four elements described above, the District Court found that the plaintiffs established only one of these—that they were likely to experience (2) irreparable harm in terms of the ability of visitors to enjoy the wilderness. However, the court found that both the (3) balance of equities and (4) public interests both tip firmly in favor of the NPS, because a core goal of the work was to “improve[] safety for the public and first responders.” The District Court explained that “[w]hen balancing injuries of an environmental nature against legitimate safety concerns, safety is the predominant consideration.” The court concluded that the equities and public interest weighed against an injunction because “While the ability of visitors to enjoy the wilderness would likely be irreparably interfered with if the injunction is denied, the weight of that concern, its substance, cannot compare to that of a legitimate plan to safeguard human lives during a wildfire” (*EII vs. Muldoon*, Case 1:22-cv-00710-AWI-EPG, Dkt. No. 71 (E.D. Cal. 2022)).

On the remaining element, the likelihood of success on the merits of the case, the District Court rejected the argument that extraordinary circumstances prohibited the use of a CE. While the presence of endangered species under certain conditions can create extraordinary circumstances, in this case the court found that NPS had appropriately consulted with FWS and engaged subject matter experts, all of whom determined that the projects would not have significant adverse impacts on endangered species. Moreover, the District Court highlighted that the park had mitigation measures in place to avoid any adverse impacts, an approach that is permitted and encouraged under NEPA.

More importantly, the court also rejected the litigant’s claim that extraordinary circumstances existed because thinning itself was “highly controversial.” The District Court quoted prior case precedent that clarified that: “A project is “highly controversial” if there is a “substantial dispute about the size, nature, or effect of the major Federal action rather than the existence of opposition to a use;” and that “Mere opposition to an action does not, by itself, create a controversy within the meaning of NEPA regulations” (*EII vs. Muldoon*, Case 1:22-cv-00710, Dkt. No. 71 (E.D. Cal. 2022)).

On appeal, the Ninth Circuit Court affirmed the District Court decision to deny the preliminary injunction in 2023. They concurred that the plaintiffs did not establish the existence of extraordinary circumstances in this case, explicitly noting that the plaintiffs “overstate[d] the controversy by mischaracterizing the projects” as post-fire logging and commercial thinning (*EII vs. Muldoon*, Case No. 22-16483, Dkt. No. 52 (Ninth Cir. 2023)). The park was very clear that this was a restoration project, that no entity profits from the sale of any timber, and that the minimal money received went directly to offset project costs. To the plaintiffs’ claim that thinning actually increases fire severity, the Ninth Circuit noted that as part of the FMP development, “the Agency was aware of and thoughtfully rejected, the objection the [litigant] raises...” and that “the [litigant] cannot use this challenge to the Projects as a backdoor means to relitigate a decision that the Agency previously made, after [public] notice and comment and a detailed environmental impact statement” (*EII vs. Muldoon*, Case No. 22-16483, Dkt. No. 52 (Ninth Cir. 2023)), referring to the FMP. In other words, the claims that thinning increases the risk of severe fires or otherwise harms the environment were not new—and as part of the public notice-and-comment period when the FMP was developed, the NPS explicitly considered these claims in the context of the best available science, and rejected them.

## Conclusions

Organizations with their own agendas have long worked to influence public opinion and the courts by capitalizing on nuance to muddy the conversation, and to reframe that nuance as scientific uncertainty (Oreskes and Conway 2010). For example, the Ninth Circuit noted that the critiques on thinning in Prichard et al. (2021) cited by the litigants were about “the deficiencies of thinning conducted *without* subsequent prescribed burns—not thinning conducted *in preparation* for prescribed burns.” The court concluded that Prichard et al. (2021) “...in fact supported the Agency’s position, concluding that... there exists widespread agreement that *combined* effects of thinning plus prescribed burning consistently reduces the potential for severe wildfire across a broad range of forest types and conditions” (*EII vs. Muldoon*, Case No. 22-16483, Dkt. No. 52 (Ninth Cir. 2023)) (emphasis in the original).

Apart from the litigation, we note that even for thinning only, neither the Prichard et al. (2021) review paper nor the larger body of literature (Chagnon et al. 2025) indicates that the potential effects are wholly unknown or in dispute. Rather, the majority of studies show that there is substantial nuance in the efficacy of thinning only, due

in part to the specifications of individual treatments, particularly in how surface fuels, including “activity fuels” (woody fuels that are created by the thinning) are dealt with. While thinning and burning combined results in fairly consistent reductions in fire severity, thinning only treatments are more variable, with some studies documenting reductions in fire severity, while others document no impact or even increases in fire severity (Davis et al. 2024; Stephens et al. 2024; Shive et al. 2024). The plaintiffs capitalized on this nuance, and on their mischaracterization of the projects, to cast doubt on the validity of the projects. But they failed to convince the courts.

As a result of the court findings that the CE was adequate, and that extraordinary circumstances did not exist, the thinning and burning work is moving ahead. When they are complete, the Merced Grove and major park roadways will be dramatically improved from both ecological and public safety standpoints. Fire’s return to the Merced Grove is inevitable, as evidenced by the six wildfires that have threatened the grove in the past 15 years alone. While the entire project is not yet complete, pile burns are scheduled for the fall of 2025, and a subsequent broadcast burn is planned for 2026. Completion of this restoration work will create forest conditions that are most likely to produce positive ecological outcomes, namely reducing future fire severity and the loss of the massive, ancient sequoias. After this sequence of treatments is completed, maintenance burns will be required in the future to keep the Grove in a condition that is resilient and resistant to severe wildfire effects.

We do want to note that the goal of this review is not to suggest when and where CEs are or are not appropriate. While recent efforts to expand the use of CEs (e.g., Fix Our Forests Act (H.R. 471)) could increase their use over time, even then, there will still be cases where it will be necessary to conduct a more in-depth analysis (e.g., and EA or EIS). Without a comprehensive NEPA analysis such as the park’s FMP in place, projects of the size and scope described here may not be appropriate for a CE, requiring new environmental analysis documents to protect critical resources and to offer the public an opportunity to comment on major federal actions.

What the *EII vs. Muldoon* case demonstrates is that when agencies design projects using the right procedural tools for the situation, and the best available science, they can prevail. This is especially important because, even as forest restoration expands across California and the western U.S., litigation—and sometimes simply the fear of litigation—is still being used to halt good projects. We hope that this case marks an inflection point for forest

management in the Sierra Nevada and elsewhere in the western U.S., beyond which agencies that have done their due diligence are more likely to stand up to lawsuits by relying on sound science. To support this, the continued production of high-quality science that clearly articulates and embraces nuance will be critical to informing forest management and supporting agencies' work to increase and maintain the resilience of western U.S. forests. Contributions to the peer-reviewed literature that directly respond to problematic studies are also critical, because they provide sound, defensible rebuttals that are backed by the weight of scientific evidence, which comes from many different scientists (e.g., see Collins et al. 2016; Fule et al. 2014; Hagmann et al. 2021; Levine et al. 2017; Safford et al. 2015, 2008; Stevens et al. 2016). In addition, publications that provide clear summaries of the core issues (e.g., Prichard et al. 2021) can aid the courts in their efforts to interpret complex and nuanced issues. Finally, scientists can support agencies by using their expertise to advise on planned projects and provide direct support (e.g., writing court declarations and support letters when allowed by the court) during legal challenges that attempt to refute the weight of the scientific evidence.

This case offers a clear and hopeful example of what is possible when the best available science, thoughtful management decision-making, and persistence align. It is cause for celebration and hope that the weight of scientific evidence will continue to prevail. After the staggering losses of so many ancient giant sequoias in recent years (Shive et al. 2021; Stephenson and Brigham 2021; Shive et al. 2022), this work could not come at a more critical time.

#### Acknowledgements

The authors did not receive any funding to prepare this manuscript. We thank John Battles for an early review of the manuscript, and the three anonymous reviewers that provided valuable feedback.

#### Authors' contributions

K.S. and S.S. wrote the main text. K.S. made the figures and G.D. reviewed and edited the manuscript.

#### Data availability

No datasets were generated or analysed during the current study.

#### Declarations

#### Competing interests

The authors declare no competing interests.

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Received: 29 October 2025 Accepted: 4 November 2025

Published online: 18 December 2025

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