National Park Service
U.S. Department of the Interior

Sequoia and Kings Canyon National Parks
Regions 8, 9, 10 and 12

FINDING OF NO SIGNIFICANT IMPACT

Re-establish Tree Seedlings in Severely Burned Giant Sequoia Groves and Adjacent Fisher Habitat

Recommended:

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Introduction

In compliance with the National Environmental Policy Act (NEPA), the National Park Service (NPS) prepared an Environmental Assessment (EA) to examine alternative actions and environmental impacts associated with a proposed project to replant giant sequoia *(Sequoiadendron giganteum*) and other mixed conifer seedlings in up to six giant sequoia groves: Redwood Mountain, Suwanee, New Oriole Lake, Dillonwood[1], Board Camp, and Homers Nose, and in an endangered fisher (*Pekania pennanti*) habitat corridor severely impacted by recent wildfires in Sequoia and Kings Canyon National Parks (parks).

The project is needed to:

1. Reduce the potential for unacceptable loss of giant sequoias—a fundamental resource that these parks were established to protect—in the limited number of groves where they naturally occur;
2. Restore proposed critical habitat for an endangered species; and
3. Avoid type conversion of these forests to high severity, frequent fire shrub communities, thereby protecting, in part, the surrounding forests from more frequent, high severity fire.

The statements and conclusions reached in this finding of no significant impact (FONSI) are based on documentation and analysis provided in a revised EA and associated decision file. To the extent necessary, relevant sections of the revised EA are incorporated by reference below.

Selected Alternative and Rationale for the Decision

Based on the analysis presented in the EA, the NPS selected Alternative 2— Replant Seedlings Grown from Seed Collected from the Local Genetic Community and Other Source Populations (the NPS' preferred alternative)— as described within the revised EA and summarized below.

As outlined in the revised EA on pages 18-35, the NPS will either monitor or plant and monitor giant sequoia (*Sequoiadendron giganteum*) and other mixed conifer seedlings in up to six giant sequoia groves in Sequoia and Kings Canyon National Parks: Redwood Mountain, Suwanee, New Oriole Lake, Dillonwood, Board Camp, and Homers Nose in those areas where these forests are otherwise unlikely to naturally recover following the impacts of high severity fire. The NPS will also either monitor or plant and monitor other conifer seedlings in the mixed conifer forest immediately south of the Redwood Mountain Grove where seed sources were also lost and in those areas where natural conifer regeneration is lower than what is estimated as necessary to re-establish this important fisher habitat corridor.

The final determination of whether regeneration is or is not sufficient in each location will follow from a decision tree, outlined beginning on page 20, and in Figure 7 (page 29) of the revised EA that incorporates: (1) analysis of remote sensing data to identify areas of concern based on post-fire conditions; (2) current conditions as measured in the field; (3) comparison of measured natural seedling densities to thresholds of natural seedling levels likely required to reestablish large sequoias to stable, self-sustaining populations within the groves (based on reference densities in Stephenson et al. 2023 in preparation) or other conifers in the fisher habitat corridor (based on the

[1] The boundary between Garfield and Dillonwood groves has historically been inconsistently defined and was mapped in a manner that did not consider ecological conditions—e.g. slope and aspect, relationship to landscape topography, etc. For the purposes of this Environmental Assessment, the portions of the Garfield grove occurring in the same drainage as Dillonwood, and therefore sharing the same ecological conditions as Dillonwood, are considered part of the Dillonwood grove.

Postfire Spatial Conifer Regeneration Prediction Tool ((PostSCRPT), Stewart et al. 2021); and (4) climate change vulnerability given site conditions such as elevation and slope.

Should application of the decision tree for any given site indicate sufficient generation and therefore point towards monitoring alone, the NPS will monitor these areas long-term. Should use of the decision tree indicate insufficient regeneration and therefore point towards the need to plant and monitor in any of the six groves or fisher habitat corridor, the NPS will develop site specific plans and document additional compliance and consultations tiered to the EA prior to implementing any planting action.

As explained in the EA, in each action area where planting is determined necessary the NPS will plant a range of between100-400 seedlings per acre. This range is based on USFS technical guidance and will be refined within each planting plan. Ultimate planting density will depend on a number of factors, including the likelihood of reburning within a decade (indicating an increase in planting density is necessary), current and future drought stress (indicating a reduced planting density is necessary), and other site-specific factors such as slope, aspect, etc. Although most seeds/cones for planting will be sourced from within the groves where planting is proposed, up to 20% of all seedlings planted could come from outside the local genetic community (from more arid groves and groves with known higher levels of genetic diversity; within seed zones 534, 540, and 550) in order to add genetic diversity to replanted giant sequoia groves.

As fully described under Planting Methods on page 33 of the EA, and as will be further described in each of the planting plans, seedlings will be planted following the Individuals, Clumps, and Openings methods outlined in North et al. (2019) across the diversity of topography and microsites (ridges, flats, depressions, along drainages, etc.) to mimic natural distribution of seedlings after fire. Following this pattern, some individual trees will be widely spaced, and others would be clustered together in small clumps. The exact planting locations of specific species will be based on their adaptations. Where some naturally regenerating seedlings occur in an area where action is determined necessary under the planting plan, extra care will be taken to avoid trampling existing seedlings. Further, if there are dense patches of regeneration within planting areas comparable to densities found after prescribed fire, the NPS will avoid planting in these areas.

Initial planting will occur over the next two years, fall 2023-fall 2025, but additional supplemental plantings could occur per area through several more years (estimated through fall 2028 or 2029) if survivorship of planted seedlings is below 70% in year one and if there is greater than 10% mortality in years 2-4. Should supplemental planting be needed, planting area/planting effort will be much smaller than those in the initial planting and will be limited to 1-2 supplemental plantings per area over the course of this longer timeframe. Please see page 32: Seedling Planting Schedule of the EA for more information.

Rationale

Alternative 2 was selected because it meets the purpose and need of the project in an efficient, effective, and safe manner. Specifically, this alternative has the same advantages of Alternative 3 in that it would restore tree seedlings to the affected areas, but it has the additional anticipated advantage of improving the overall ability of sequoias specifically to persist under an uncertain climate future due to the addition of genetic diversity.

Mitigation Measures

The NPS places strong emphasis on avoiding, minimizing, and mitigating potentially adverse environmental impacts. Therefore, the NPS will implement multiple mitigation practices to protect wildlife, plants, special status species, cultural/historic/ethnographic resources, acoustic environment, wilderness resources, human health and safety, and visitor use and experience. These measures and practices are described in detail in Appendix A of the revised EA. These mitigation measures and best management practices are included as integral parts of the selected alternative. The NPS has the authority to implement the mitigation measures under the Organic Act, the Wilderness Act, the National Historic Preservation Act, NPS Management Policies 2006, park-specific regulations, and other federal and state applicable requirements.

Other Alternatives Considered

In addition to the selected alternative, the EA analyzed two other alternatives and their impacts on the environment: Alternative 1, the No Action Alternative, and Alternative 3, Replant Seedlings Grown from Seed Collected from the Local Genetic Community of Each Replanted Area.

Alternative 1: No Action

The No Action Alternative, described on page 18 of the revised EA will not be selected. Under Alternative 1, the NPS would not consider replanting any severely burned sequoia groves or adjacent proposed fisher critical habitat. Rather, the NPS would continue to monitor species succession within former sequoia grove footprints within Redwood Mountain, Suwanee, New Oriole Lake, Dillonwood, Board Camp, and Homers Nose Groves as well as plant distributions in the proposed fisher critical habitat adjacent to Redwood Mountain Grove. For the purposes of analysis, the EA assumes that monitoring would involve development of monitoring plots which may include installation of 600 small plot markers, such as rebar, as well as 60 other installations, such as temperature and moisture probes, to characterize and understand microclimatic factors. The NPS also assumes these markers would remain for at least 30-40 years to track conditions. Previously collected seed would remain in the seed bank for research and potential planting in the future, and seedlings that have been germinated would be transferred to partner organizations or agencies for their use.

Under Alternative 1, and as clarified in the revised EA, the NPS anticipates that sequoia and other conifer seedlings would be more likely to remain either absent or at densities below that needed to support forest recovery in affected areas than the action alternatives. As such, these areas are more likely to convert to fire-initiated shrub-dominated communities for decades, if not centuries to come. Loss of forest cover would lead to diminished natural quality of wilderness character in the long term. In addition, because fisher habitat connectivity between remaining green forest patches would not be restored, fisher genetic exchange would be diminished as well as that of other forest dependent wildlife. Fire frequency and severity would also likely increase as the vegetation converts to shrub-dominated communities without tree cover.

Alternative 3: Replant Seedlings Grown from Seed Collected from the Local Genetic Community of Each Replanted Area

Alternative 3 will not be selected. Alternative 3 is described on pages 35-36 of the EA. Alternative 3 is the same as the selected alternative in that the NPS would adopt a framework to consider future action within the same areas impacted by high severity fire and would implement the same methodologies for such action. However, under Alternative 3, the NPS would not add genetic diversity to replanted giant sequoia groves by sourcing cones/seed from arid groves and from groves with known higher levels of genetic diversity within the seed zone. Instead, all seed would be collected only from within the local genetic community (or neighborhood) of the grove being replanted as described in Appendix E.

All methods of seed collection, propagation, planting, and transport would follow methods previously outlined in the selected alternative.

Public Involvement and Agency Consultation

Public Scoping and EA Review

The NPS solicited public feedback during a 30-day public comment period in early 2022 (February 22 to March 25, 2022) on a proposed action to plant seedlings in the Board Camp Grove. Then in early 2023 (February 17), the NPS re-initiated another 30-day public comment period on an expanded proposal to re-establish tree seedlings in Board Camp Grove and up to six other areas. Following these scoping periods, the NPS prepared the *Re-establish Tree Seedlings in Severely Burned Giant Sequoia Groves and Adjacent Fisher Habitat Environmental Assessment* and released the document to the public for a 30-day public review period extending from July 7 through August 6, 2023.

All project information, including scoping materials and the EA, were shared on the National Park Service's (NPS) Planning, Environment, and Public Comment (PEPC) website, which was also linked to from the park's website. The availability of scoping documents, comment period dates, and associated public meetings were also announced through individual press releases, one for each scoping effort and for the public review period. All press releases were sent directly to the public affairs contacts list, which included media; congressional members; non-profits; local businesses; community members; local, state, and federal government stakeholders; and members of the public. The press releases for the second public scoping effort and public review of the EA were also sent directly to all functional email addresses of correspondents on the previous scoping efforts as well as other parties who had demonstrated a high level of interest in the proposals. Public comments were accepted via the PEPC website, letter, as well as email.

The NPS also held virtual public meetings during all public comment periods: March 1, 2022, during the first public scoping effort (22 attendees), March 7, 2023, during the second public scoping effort (41 attendees), and July 25, 2023, during the public review period for the EA (20 attendees). During these meetings, staff presented on the purpose and need for action, the full scope of the proposed action, resources of concern, and the overall project timelines. NPS staff also accepted and responded to questions from the public. In addition to these meetings, the NPS scheduled two public site visits and one tribal site visit to the area during the public review period for the EA and invited the public and tribes to join NPS staff onsite to discuss the EA during that time. Roughly 13 members of the public contacted the NPS to join these site visits, and the NPS was able to accommodate all their requests; 10 members of the public ultimately attended one of the two scheduled site visits.

NPS' public scoping effort for Board Camp resulted in the receipt of 2,800 pieces of correspondence while the expanded project scope resulted in the receipt of approximately 1,937 pieces of correspondence. The majority of correspondences from both scoping efforts were form letters. All correspondences were reviewed by park staff and considered in the decision-making process.

The NPS documented roughly 1,830 individual pieces of correspondence during the public review period for the EA submitted via PEPC or via mail. Individual NPS staff also received roughly 60 individual correspondences to their personal NPS personal email addresses despite this not being an official method for submission. The NPS' reviewed all correspondence received no matter the method submitted. Responses to both substantive comments and other comments or concerns raised during the public review period that the NPS thought would benefit from clarification are summarized in Appendix B.

Consultation with Tribes

The NPS initiated consultation with Tribal Chairs of the parks' 14 formally recognized affiliated tribes and additional Native American interested parties on February 17, 2023, and continued consultation through letters dated July 17 and 18, 2023, and a tribal forum on September 8, 2023. The NPS received two responses from Native American interested parties requesting additional maps and expressing both a willingness to help the NPS and overall support of the proposed action.

National Historic Preservation Act

The NPS informed the State Historic Preservation Officer (SHPO) on the development of this EA on February 17, 2023, through a press release shared directly with agency partners. The NPS determined that the project, as defined for the purposes of NEPA, need not necessarily equate to the undertaking as defined pursuant to 36 CFR § 800.3(a) and determined that the NEPA project planning area will not be used to define the undertaking or Area of Potential Effect (APE) for the purposes of the National Historic Preservation Act (NHPA). Each treatment area will have independent utility, individual approval processes, and is not inextricably connected to other treatments. Because the areas are independent and undergo separate approval processes, each treatment or subset of treatments addressed by an implementation plan will be considered individual undertakings under NHPA, and Section 106 compliance will be fulfilled in accordance with provisions of the 2008 Nationwide Programmatic Agreement. A representative of the SHPO agreed with this approach in June 2023.

While the NPS has completed background research and has initiated consultation with tribal partners to identify historic properties within the areas of potential effect, field surveys in all portions of the areas of potential effect have not been completed as of this writing. Therefore, as consistent with 36 CFR 800.1(c), if site specific, non-destructive, analyses indicate planting is necessary to achieve the purpose and need for action (this process is articulated in the selected alternative as part of the decision tree; see Figure 7 in Chapter 2), cultural resources surveys would be completed, as appropriate, on a site-by-site basis, and consultation with the State Historic Preservation Officer and tribes, in accordance with 36 CFR 800.3 through 36 CFR 800.7, would be completed to assess the effects of each undertaking and seek ways to avoid, minimize, or mitigate any adverse effects on historic properties (should they be present within the area of potential effect) through the refinement of an area's specific planting plan. Through this additional identification of historic properties and consultation process on an area's site-specific planting plan, and again, given the limited degree of potential disturbance from the proposed action, the NPS anticipates avoiding adverse effect to historic properties.

Endangered Species Act

The NPS informed the U.S. Fish and Wildlife Service (USFWS) of the development of this EA on February 17, 2023, through a press release shared directly with agency partners. Per the USFWS' Programmatic Biological Opinion on Proposed Activities of the National Park Service that May Affect the Southern Sierra Nevada Distinct Population Segment of Fisher (08ESMF00- 2020-F-2011-1), the NPS initiated Section 7 consultation for proposed actions related to this proposal that may affect the endangered fisher on July 7, 2023, requesting USFWS concurrence that the project may affect but is not likely to adversely affect the Southern Sierra Nevada distinct population segment of the fisher.

The USFWS responded on August 21, 2023, concurring with the determination that the project may affect but is not likely to adversely affect fisher for the following reasons: 1) the proposed project area currently does not contain suitable fisher habitat due to the impacts of recent fires; and, therefore, fishers are not expected to be present in the project area; 2) the small scope of noise disturbance from creating safety zones and delivering supplies via helicopter will not cause long-term disturbance in the planting areas. Fishers in the vicinity of these areas may avoid the immediate area for a short time, but they would use other areas available during this time and this is not expected to result in a disruption of necessary foraging and other activities; 3) although denning fishers are not expected in the project area, the limited operating period for felling of trees with den features will further ensure no adverse impacts to denning fishers occur; and 4) restoration of habitat connectivity and fire-resilient forest conditions is expected to provide an overall benefit to fisher (FWS-2023-0111204-S7-001.) All conservation measures outlined in the consultation were incorporated into the mitigation measures outlined in Appendix B of the EA and are subsequently incorporated into the selected alternative via this decision.

Finding of No Significant Impact

Implementing the selected alternative will not result in significant adverse impacts on public health, public safety, or unique characteristics of the region. No highly uncertain or controversial impacts, unique or unknown risks, significant cumulative effects, or elements of precedence were identified. Implementation of the NPS selected alternative will not violate any federal, state, or local environmental protection laws.

The following summarizes project effects, including beneficial effects, anticipated to result from implementing the selected alternative.

Sequoia Grove Recovery and Resilience

As described on pages 52-54 of the revised EA, if, as data suggest, natural regeneration is ultimately insufficient to restore stable sequoia populations, replanting portions of up to six affected sequoia groves is anticipated to restore seedlings up to roughly 700 acres of affected groves at densities expected to direct the trajectory of severely burned areas toward forest recovery (a sustainable population) of their pre-fire conditions. If, as anticipated, planting is successful, the selected alternative has a greater chance of resulting in beneficial effects to sequoia grove recovery than the no action alternative. Once seedlings are established, the NPS anticipates that natural and dynamic post-fire recovery processes will continue, and the seedlings will mature over a period of centuries, such that large sequoias will be the dominant feature within most, if not the entire, grove footprint. Overall, the NPS anticipates that grove area and large sequoia density will largely be restored to pre-fire conditions in each of the six groves and that these groves will continue to naturally adapt to future conditions.

The NPS recognizes that future fire effects are not fully known due to the unprecedented scale of high severity fire experienced by these groves and associated unknowns with how fuels will accumulate post-fire. However, under the selected alternative, the NPS anticipates long-term re-establishment of tree cover through replanting will shade out some of the shrub cover and return fire and fuel dynamics to those of the fire return interval characteristic of sequoia groves. This will likely result in more beneficial and natural fire effects when compared to taking no action.

Regardless of NPS action or inaction, the NPS anticipates that the genetic structure of the groves within the action areas will change in the future in response to immigration, emigration, and selection (Allendorf et al. 2007). There is little risk of the selective alternative negatively impacting population fitness as those individuals not adapted to future stressors will perish and fail to pass their genes to the next generation. Based on NPS' understanding of sequoia genetics and outbreeding depression, the NPS concludes that adding 20% nonlocal genotypes will limit potential risks and maximize adaptive benefits to recovery and resilience of giant sequoia groves, which will increase the potential for long-term success and tree survival (see also Appendix E of the revised EA).

The NPS has not identified negative effects to Sequoia Grove Recovery and Resilience from planting sequoia seedlings. When considered collectively with fuels management actions being undertaken in other sequoia groves within these parks under both the Fire and Fuels Management Plan and the Emergency Fuels Reduction project within SEKI Sequoia Groves, as well as sequoia restoration projects being undertaken regionally by federal land management agencies, tribes, and others, this project will contribute cumulatively and beneficially to resiliency of sequoia groves within both Sequoia and Kings Canyon National Parks and range wide. Given their limited range, and the relative ecological and societal importance of giant sequoias as a resource, these beneficial effects will likely be substantial.

Fisher Habitat Connectivity

Planting the 485-acre fisher habitat corridor will help to speed up the growth of tree cover in areas where facilitating safe movement of fisher can yield the greatest relative benefit on the landscape.

Because this area of mixed conifer forest is one of the "pinch points" identified as a high priority for restoration, restoring this area is particularly important for providing a linkage between forested areas on either side that were unchanged or burned at low to mixed severity and therefore retain green trees (Meyer, et al. 2022). At some point, this 485-acre area will likely become indistinguishable, in terms of habitat suitability and use, from green forest patches currently occupied by fisher on either side of the proposed planting area.

In addition to direct beneficial effects on habitat suitability and connectivity, re-establishment of tree cover would indirectly benefit fisher by improving habitat suitability for key fisher prey species (e.g., tree squirrels) and large-bodied primary cavity excavators (e.g., pileated woodpecker) that play an important role in creating reproductive den cavities for female fishers. See pages 60-61 of the revised EA for additional detail on the effects of the selected alternative on fisher habitat connectivity.

Decisions to either suppress wildfire, allow fire to burn, or implement other fire management activities may also cumulatively affect fisher habitat connectivity in the long term. What actions, if any, might be necessary to address fire resilience and the impacts of those actions in the action area will need to be evaluated and addressed in the future as fuels accumulate across the action area. However, the NPS expects that this project, when considered alongside previously approved actions to manage fuels through thinning and prescribed burning, as is ongoing in many developed areas as well as some areas of wilderness in these parks, will cumulatively and beneficially affect fisher habitat connectivity.

The NPS has not identified negative impacts of this project on fisher habitat given that the selected alternative will improve fisher habitat connectivity in the long term, and the NPS will continue to manage fuels for ecological benefit.

Wilderness Character

Untrammeled Quality

Planting tree seedlings in wilderness, as will occur under the selected alternative, will negatively affect the untrammeled quality over an area up to 1,131 acres of wilderness for the first planting year, though this acreage would be less should the NPS determine action is not warranted in some areas (see page 67 of the revised EA). In areas where a high number of tree hazards were removed, this would also impact the untrammeled quality, though these impacts would occur only in the first year. Negative effects to the untrammeled quality will occur to a greater degree than would have occurred under the other action alternative (Alternative 3) due to the introduction of non-local genetic material. Should additional planting be necessary after the first year, trammeling is anticipated to continue to occur in smaller portions of the action area each year planting is completed for a period of up to a total of approximately five to six years (estimated at one to two times per grove following the initial planting). The total area where trammeling actions will occur under the selected alternative will decrease annually as high seedling survival is anticipated in the first year and every year after. As well, trammeling actions will occur over a shorter timeframe if planting achieved minimum densities during initial planting attempts. Once planting actions entirely cease (after approximately five to six years), the influence of this action on the untrammeled quality will cease.

This alternative will increase the cumulative total number of acres trammeled annually within these wildernesses by roughly 1,000 acres the first year planting would occur and decreasing annually thereafter. Annually, the cumulative period of time over which trammeling actions will occur within these wildernesses will also increase by roughly four weeks the first year and to a lesser degree annually thereafter for the next five to six years as planting efforts and areas decrease.

Impacts to untrammeled quality described above would occur a maximum of 2-3 weeks (the maximum duration of time that a given planting would occur), in a given year and over a small percentage of wilderness. Given the small size of the area, that these impacts are temporary, and that as a whole wilderness will continue to be dominated by natural processes, these impacts will not be significant.

Natural Quality

Under the selected alternative, replanting of up to six affected sequoia groves and adjacent fisher critical habitat will have a greater likelihood than Alternative 1 of restoring sequoia and mixed conifer seedlings in up to 1,131 acres of wilderness. Were the restoration to be successful, it is expected to direct the trajectory of severely burned areas toward forest recovery to their pre-Castle and KNP Complex fire conditions, beneficially affecting sequoia grove recovery and proposed fisher critical habitat and connectivity. As described in impacts from the selected alternative to Sequoia

Grove Recovery on pages 52-54 and to Fisher Habitat Connectivity on page 60 in the EA, the NPS anticipates that once seedlings are established, natural and dynamic post-fire recovery processes will continue, and the seedlings will mature over a period of centuries, such that large sequoias would be the dominant feature within most, if not the entire, grove footprints.

Similarly, over a period of 50-100 years and beyond, stand structure is expected to continue to improve and habitat value would continue to increase across the 485-acre fisher habitat corridor project area which will, in turn, facilitate fisher movement dispersal and associated gene flow vital to the species conservation and meet fisher habitat requirements for foraging, resting, denning, and predator avoidance.

These impacts should thereby long-term restore and beneficially affect, to the same degree as it impacts the species mentioned above, the currently diminished natural quality of wilderness character in planting areas. As also described in the impacts from the selected alternative to Sequoia Grove Recovery and Resilience, the selected alternative will also be more likely than Alternative 1 to prevent the long-term conversion of these forests to shrub-dominated communities and the transition to a fire regime typical of these communities—one that is characterized by more frequent, high severity fire. In doing so, the selected alternative best maintains the fire regime of these forests and reduces the chances that high severity fire from shrub-dominated communities travels to and through surrounding groves and mixed conifer forests that remain intact.

Though genetic diversity is low in Sequoias, the species does show some evidence of local adaptation, specifically related to summer temperatures and precipitation (DeSilva and Dodd 2020; De La Torre et al. 2021), meaning that groves which are currently more arid have adaptations to improve their survival and fitness to high temperatures and drought. Therefore, seedlings propagated from a variety of sources may demonstrate increased survival capacity, increasing the from other sources prove key to successful replanting of these areas, the selected alternative will⁄n beneficially affect natural quality of wilderness character to a greater degree than other alternatives considered; though the characteristics of the population will be different from what would otherwise have been present. See impacts from Alternative 2 to Sequoia Grove Recovery and Resilience in the revised EA.

The selected alternative, when considered with other ongoing restoration actions described in the EA, is likely to result in cumulative beneficial effects to natural quality across these wildernesses if, as anticipated, sequoia groves and mixed conifer forests are restored over approximately 1,131 acres such that natural quality will be preserved, and improved, in the long-term.

Undeveloped Quality
Under the selected alternative, the undeveloped quality will be negatively affected by the installation of up to 600 monitoring stakes, should installations be determined necessary for that purpose. The undeveloped quality will also be negatively affected by up to one to six sling load helicopter landings and roughly two to three hours of chainsaw use (when determined necessary) at each planting location the first year of planting, and up to one to two sling-load landings during each subsequent planting (estimated as one to two per planting location over the next five to six years) (see Table 3 on page 35 of EA). The negative effects on undeveloped quality from motorized tool use and transport will return to pre-project levels once those tools are no longer being used.

If chainsaws or hand tools, rather than explosives, were used to fell snags, evidence of up to ten large cut stumps per delivery location, and up to roughly 40 smaller stumps for camp locations, would result in additional, though minimal, negative effects on undeveloped quality until stumps deteriorate naturally—a period of typically 10-20 years, depending on stump diameter and tree species. The small tree wells created around each seedling would likewise have a minor, though negative, effect on undeveloped quality until the wells are no longer evident on the landscape—a period of one to two years post planting. Despite these temporary impacts to undeveloped quality, the undeveloped quality would be preserved in the long term as all impacts to this quality would cease within approximately five years but for the potentially few visible stumps across the landscape, which would diminish in the 10–20-year timeframe.

In locations where planting occurs, the selected alternative will cumulatively increase negative impacts to undeveloped quality occurring annually in these wilderness areas by up to three to six hours of motorized tool use and up to a total of roughly 20 minutes total helicopter landings in the first year, and decreasing annually thereafter. Finally, this alternative will increase the total number of monitoring installations in wilderness by roughly 600 small plot markers and 60 small monitoring devices.

At the end of each planting action (a total of under roughly seven hours over the course of several days in the case of motorized equipment and mechanical transport in the first planting year) most of the impacts to the undeveloped quality described above will cease until the next planting action. However, impacts to the undeveloped quality will continue for 40 years in the case of monitoring installations. Given the size of the entire action area (1,131 acres), in the context of the nearly 840,000 acre wilderness as a whole, and the limited duration of impacts to the undeveloped quality, these impacts are not significant. The undeveloped quality will be preserved in the long term.

Opportunities for Solitude or Primitive and Unconfined Recreation Quality

This project will not affect opportunities for primitive and unconfined recreation, however, as with undeveloped quality, if use of helicopters and chainsaws are determined the minimum tool necessary under tiered compliance documentation, opportunities for solitude will be negatively affected by sights and sounds of up to roughly 37 helicopter flights traveling over wilderness for up to 30 minutes per flight to each location over the course of approximately five to six years. The use of chainsaws running for up to an estimated two to three hours at each location to potentially fell snags within the first year of planting will further negatively affect opportunities for solitude (see Appendix D, Table D 1). But if explosives were used to fell snags (instead of chainsaws), the impacts to opportunities for solitude will be more intensive and far reaching, but of shorter duration—a period of seconds. Finally, the sights and sounds of mule strings (8 mules per string for a total of up to 98 strings in Redwood Mountain area only) and 10-15 tree planters will negatively affect solitude up to 2-3 weeks annually per area over the course of up to five years per area (see Table 3 on page 35 and Appendix D, Table D1 in EA). Impacts to opportunities for solitude will be greatest in cases where personnel would camp overnight in wilderness and in the Redwood Canyon area where project work will occur for a longer duration (roughly 4 weeks: 2 weeks for the Grove and 2 weeks for the proposed fisher critical habitat area).

The selected alternative will contribute to a cumulative increase in impacts to this quality occurring on an annual basis with similar intensity and duration to those described under the undeveloped quality above. However, the selected alternative will also cumulatively contribute to the annual total number of crew camps (roughly three additional camps) and administrative workers (roughly 30-40 additional workers) in wilderness for roughly four weeks annually. As well, the selected alternative will also cumulatively contribute to the annual length of time where helicopter sounds can be heard and seen within the wilderness by roughly 6-10 hours total per year (see Table 3 of the EA for details on proposed helicopter flights and travel distances).

Given the limited area affected (including all work areas, flight paths, and landing zones), the limited duration of the project, and the widespread outstanding opportunities for solitude or primitive and unconfined recreation throughout the surrounding wilderness, all impacts described above will not be significant. Opportunities for solitude or primitive and unconfined recreation quality of wilderness character will be preserved in the long term.

Conclusion

As described above, the selected alternative does not constitute an action meeting the criteria that normally requires preparation of an environmental impact statement (EIS). The selected alternative will not have an adverse significant effect on the human environment in accordance with Section 102(2)(c) of NEPA.

Based on the foregoing, it has been determined that an EIS is not required for this project and, thus, will not be prepared.

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Appendix A:
Non-Impairment Determination

The Prohibition on Impairment of Park Resources and Values

NPS Management Policies 2006, §1.4.4, explains the prohibition on impairment of park resources and values: "While Congress has given the Service management discretion to allow impacts within parks, that discretion is limited by the statutory requirement (generally enforceable by the federal courts) that the Park Service must leave park resources and values unimpaired unless a particular law directly and specifically provides otherwise. This, the cornerstone of the 1916 Organic Act, establishes the primary responsibility of the National Park Service. It ensures that park resources and values will continue to exist in a condition that will allow the American people to have present and future opportunities for enjoyment of them. The impairment of park resources and values may not be allowed by the Service unless directly and specifically provided for by the legislation or by the proclamation establishing the park. The relevant legislation or proclamation must provide explicitly (not by implication or inference) for the activity, in terms that keep the Service from having the authority to manage the activity so as to avoid the impairment."

What is Impairment?

NPS Management Policies 2006, §1.4.5, What Constitutes Impairment of Park Resources and Values, and §1.4.6, What Constitutes Park Resources and Values, provide an explanation of impairment. "Impairment is an impact that, in the professional judgment of the responsible NPS manager, will harm the integrity of park resources or values, including the opportunities that otherwise will be present for the enjoyment of those resources or values." Section 1.4.5 of Management Policies 2006 states:

> An impact to any park resource or value may, but does not necessarily, constitute impairment. An impact would be more likely to constitute impairment to the extent that it affects a resource or value whose conservation is:
>
> - Necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the park, or
> - Key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park, or
> - Identified as a goal in the park's general management plan or other relevant NPS planning documents as being of significance.
>
> An impact would be less likely to constitute an impairment if it is an unavoidable result of an action necessary to preserve or restore the integrity of park resources or values and it cannot be further mitigated. An impact that may, but would not necessarily, lead to impairment may result from NPS activities in managing the park, visitor activities, or activities undertaken by concessioners, contractors, and others operating in the park. Impairment may also result from sources or activities outside the park.

Per §1.4.6 of Management Policies 2006, park resources and values at risk for being impaired include:

- "the park's scenery, natural and historic objects, and wildlife, and the processes and condition that sustain them, including, to the extent present in the park: the ecological, biological, and physical processes that created the park and continue to act upon it; scenic features; natural visibility, both in daytime and at night; natural landscapes; natural soundscapes and smells; 11 water and air resources; soils; geological resources; paleontological resources; archeological resources; cultural landscapes; ethnographic resources; historic and prehistoric sites, structures, and objects; museum collections; and native plants and animals;
- appropriate opportunities to experience enjoyment of the above resources, to the extent that can be done without impairing them;
- the park's role in contributing to the national dignity, the high public value and integrity, and the superlative environmental quality of the national park system, and the benefit and inspiration provided to the American people by the national park system; and
- any additional attributes encompassed by the specific values and purposes for which the park was established."

Impairment Determination for the Selected Alternative

Based on the evaluation of potential impacts identified in the EA, the topics evaluated for impairment include the following:

<u>Cultural Resources</u> – As documented in the EA and in NPS' Assessment of Effect, should historic properties be present within these groves and fisher habitat, ground disturbance associated with planting activities, could have long-term direct and indirect impacts on cultural resources should tree seedlings be planted and grow within or directly outside archeological site boundaries. However, these impacts will be minimized, if not eliminated, through avoiding planting in identified sites and using an avoidance buffer outside the site. Given the ability to refine each area's specific planting plan to avoid action within historic properties (if present), the project is unlikely to affect historic properties and will not directly, indirectly, or cumulatively result in impairment to these resources.

<u>Invasives Species and Soil Pathogens</u> – As documented in the EA, and as further described in the revised EA, planting seedlings and workers traveling off-trail through forested areas have the potential to disturb soil and result in the importation of contaminated fill, providing an opportunity for invasive species or soil pathogens to be introduced to the parks or become established and spread. Invasive plant seeds and propagules can also be introduced to the parks and transferred between project areas on project equipment, tools, and clothing. However, seedlings used in this project will be sourced from reforestation nurseries where best management practices employed by these nurseries will result in the project having a low risk for soil pathogens or invasive plant propagules being introduced via seedling sources. The application of mitigation measures including equipment and clothing inspections will further prevent the potential for invasive species introduction or persistence over existing conditions. Given the implementation of best management practices and mitigations both associated with this project and all other projects involving use of nursery grown plants or where propagules could otherwise be inadvertently transported, this project will not directly, indirectly, or cumulatively result in the impairment of vegetation and soils through the introduction of invasive species or soil pathogens.

<u>Soils and Soil Erosion</u> – Actions that disturb soil, including digging and foot traffic, can contribute to soil erosion, while restoring vegetative cover and roots serve to protect and stabilize soils.

However, planting crews will minimize their contribution to soil erosion in these areas to the maximum extent feasible by limiting the hole sizes to the minimum needed to plant seedlings, avoiding sensitive areas, and avoiding creation of social trails such that this project will not contribute to extensive soil disturbance beyond that already occurring in the system post fire. Given the limited potential for soil disturbance associated with project implementation, that project mitigations put in place to further prevent such impacts, and that all projects involving soil disturbance in these parks incorporate similar measures, the project will not directly, indirectly, or cumulatively result in the impairment of soil resources. Further, restoring forest cover is expected to benefit soils by stabilizing them against further erosion in the long term.

Wildlife, including Fisher – Tree planting crews, or mule pack trains delivering supplies, could trample delicate herpetofauna (i.e., salamanders, toads, frogs) causing injury or mortality to herpetofauna, though will have no impact to such fauna on a population level. As well, the presence of work crews—working and in some cases camping—in each of the seven planting areas over the course of five to six years, may startle or temporarily displace other wildlife (black bear, mule deer, various small mammals, reptile, and bird species) from these areas if they were present. For areas where seedlings need to be transported via helicopter, wildlife may be additionally impacted by removal of several snags per landing site, when necessary, which otherwise provide some habitat to birds and small mammals, and the noise associated with chainsaw or explosive use (if needed to create a helicopter sling load landing zone) and helicopter use.

While disturbances from human presence may occur, due to the current conditions of the affected environment in the action area (severely burned with little vegetation), the NPS expects wildlife use within large patches of high severity burn—by many species—will be limited during the timeframe of the planned activities (Fontaine and Kennedy 2012; Eyes et al. 2017; Jones et al. 2020); though wildlife use is expected to increase as the understory vegetation begins to recover and leaf litter begins to develop. However, for many species, the remaining live forest habitat adjacent to the proposed action areas offer habitat where wildlife can move to (if needed) to avoid human presence while continuing daily foraging or resting activities.

Due to the transitory nature of helicopters flying along a flight path, the NPS anticipates there will be no direct wildlife impacts (startling response or avoidance behavior) from this component of the action. While higher intensity actions (i.e. helicopter sling load deliveries or use of chainsaws or explosives) will disturb wildlife if present, these actions are of short duration (1-2 hours total at each site in the case of chainsaws, 10 seconds in the case of explosives, 5 minutes at a time in the case of sling load delivery). Therefore, wildlife are expected to recover—continue foraging or other activities—relatively soon after the chainsaw or explosive use ceases or the helicopter moves away, and no long-term impacts to wildlife (especially any sensitive species in the area) are expected.

The NPS will also protect wildlife and comply with the Migratory Bird Treaty Act and the Bald and Golden Eagle Protection Act by implementing relevant U.S. Fish and Wildlife Service Nationwide conservation measures and additional NPS-developed measures. All other short-term, direct impacts associated with project implementation are expected to be limited to those temporary impacts described above, and the NPS will implement mitigations to further minimize, if not avoid, impacts such that the project will not directly, indirectly, or cumulatively result in the impairment of wildlife resources.

In the long term (a period of 10-50 years and beyond), re-establishment of forest cover will improve habitat suitability in the proposed action area for wildlife that prefer sequoia and mixed conifer forest (as opposed to shrub-dominated areas), such as fisher (as further described in Chapter 3), pileated and white-headed woodpecker, tree squirrels (e.g., Douglas squirrel, Humboldt's flying squirrel), Sierra marten, western spotted skunk, and other forest dependent species.

California Spotted Owl – The NPS does not expect that the activity of planting of trees, the presence of work crews planting or camping in these areas, and/or the use of mules in severely burned areas will disturb owls, have a direct effect on individual owl nests, influence survival, or alter prey availability in active territories. Further, 85-90 dB noise from helicopters traveling over areas where owls are present is unlikely to result in an alert response for owls (Jones et al. 2020; Tempel et al. 2016; Pater et al. 1995).

Owls, if present, may directly experience noise disturbance for roughly 20-40 minutes over the course of five to six years in areas where sling-loads are delivered, and either up to 110 dB sound intermittently for roughly two hours over the course of one to two days if trees were felled using chainsaws, or up to 180 dB sound for five to ten seconds over the course of one day were trees to be felled using explosives. If owls were resting within 350 feet of such activities, these disturbances may cause them to "flush" (be startled into taking off and leaving the immediate area in a state of heightened stress) (Jones et al. 2020; Tempel et al. 2016; Pater et al. 1995).

As snags will be felled in preparation for sling-load delivery in some locations, potential disturbance from these two actions will be separated in time such that any owls that were present may experience noise disturbance on two separate days or multiple times over the course of one day. This said, as with other wildlife, the NPS does not expect spotted owls to be utilizing or nesting in areas where either tree planting or sling-load delivery would occur until vegetation—particularly the overstory canopy—begins to recover (a period of five to ten years) (Jones et al. 2020; Tempel et al. 2016).

Even were owls to be present during project activities, the NPS will avoid impacts to nesting owls by either conducting higher-disturbance activities (sling-load delivery or chainsaw use) entirely outside the owl nesting LOP (April 1-August 15) or not conducting these activities within the standard 0.25 miles nesting buffer where nests are documented. As well, helicopters, explosives, or chainsaw use will be of limited duration and occur in areas where owls are unlikely to be present (Jones et al. 2020; Tempel et al. 2016). For these reasons, this component of project implementation is not expected to impact nesting owls. Disruption to owl resting activities, if any were present in or near the action area, will be intermittent and of short duration.

Though temporary impacts may occur under the selected alternative, were owls to be present or nesting in the project areas, such impacts will not directly or indirectly, or cumulatively result in impairment of spotted owl and the NPS will implement mitigations to further limit impacts. Further, taking action will be largely beneficial for spotted owl in the long term as the NPS anticipates that forest cover will be largely restored across planting areas under the selected alternative.

Understory Vegetation—Including Special Status Plants or Shrub Communities – Though some trampling of vegetation generally will be expected due to the nature of the work, planting sequoia and other mixed conifers in areas that are unlikely to recover on their own will better enable forest recovery. Were forest recovery to be successful, it will provide a greater benefit to special status plants that may have survived high severity fire by providing suitable habitat in the future once forests are re-established.

This project will not impede natural sequoia regeneration via competition between natural regeneration and planted seedlings because the selected alternative does not propose to plant seedlings in areas with adequate sequoia regeneration post fire, and the NPS would plant species based on species assemblages in the planting areas.

Due to anticipated low likelihood of current occurrence combined with minimal disturbance (potentially being trod upon once) and application of mitigations to further reduce potential impacts, the NPS does not expect that implementing the selected alternative will result in loss of special status or rare plant populations been present prior to the fires (and may either still occur in the area or in the immediate vicinity) and further, that these species will benefit from forest recovery as they are adapted to forested habitat.

Other common plant species, e.g., ceanothus species and other perennial shrub species, that exist in the action area are resistant to disturbance, including trampling at the levels expected for this project, or are so common that even were individuals lost, it will not affect the population as a whole. That said, if, as expected, tree seedlings that are planted become successfully established, shrub communities that would otherwise become increasingly established in burned areas will be crowded out over an estimated period of 50-100 years as the forest canopy recovers and competition with trees for light and water increase. However, this process would have also occurred naturally in these areas had they not burned at such high severity.

In summary, due to a combination of low probability of occurrence for special status plants, their reproductive life history strategy making their populations resilient to limited trampling generally, as well as mitigations that limit trampling to the maximum extent feasible, the selected alternative project will not directly, indirectly, or cumulatively result in the impairment of these vegetation resources.

<u>Sequoia Groves</u> – Planting sequoia seedlings under the selected alternative is expected to largely restore grove area and large sequoia density to pre-fire conditions in each of the sequoia groves where planting will occur, beneficially affecting sequoia groves. In sum, implementation of the selected alternative will not directly, indirectly, or cumulatively result in impairment of Sequoias and will instead beneficially affect sequoia grove recovery and resilience as described further below.

Resilience to Future Change
By increasing the genetic diversity of local populations, the selected alternative is expected to beneficially affect the overall ability of sequoias to persist in the long term for several reasons.

Some sequoia groves in more arid environments show evidence of adaptations to summer temperatures and precipitation (DeSilva and Dodd 2020; De La Torre et al. 2021), suggesting that groves which are currently more arid have genetic adaptations to improve their survival and fitness to higher temperatures and drought. Based on this finding, De La Torre et al. (2021) concluded that some groves, including Redwood Mountain Grove, will need increased genetic diversity to adapt to a warming climate. In addition to selecting for adaptation to drought, adding genetic diversity, particularly to small groves, will provide more options for sequoias to adapt to unforeseen factors in the future (Broadhurst et al. 2008; Aitken and Bemmels 2016). Based on these studies, the ecology of conifers, and their responses to past environmental changes, the NPS expects that increasing genetic diversity will boost overall grove resilience to future environmental changes including potential new pathogens, altered wildfire regimes, increasing temperatures, and hotter drought

Regardless of the seed source, the restored grove will increase the areas across which each grove can recover from environmental events (e.g., extreme flooding, the next high severity wildfire, or pathogens) because groves that occupy a larger area with more varied topography and microhabitats are both buffered by size and variable conditions from being lost due to a single event or stressor. Similarly, over a period of many decades, the NPS anticipates planting sequoia seedlings will result in observed re-establishment of reproductive sequoias, restoring the regeneration potential to the affected groves. As the trees mature, they will create greater quantities of cones and seed and across a broader geographic area, bolstering their ability to respond to disturbance and environmental change in the future.

Future Fire Effects
As the standing dead trees fall and shrubs and herbaceous plants become established, there will be an increased potential for reburn at high severity, which could kill planted seedlings and those naturally regenerating (Coop et al. 2020). Planted seedlings' risk to reburning will be expected to peak between roughly 7 and 20 years, as fuels accumulate but saplings are not yet able to survive high fire intensities to ensure grove recovery (A.Caprio personal communication 2022; York et al. 2021; Coppoletta et al. 2016), however, future fire effects are not fully known due to the unprecedented scale of high severity fire experienced by these groves and associated unknowns with how fuels will accumulate post-fire. This said, the NPS anticipates long-term re-establishment of tree cover through replanting such that established trees will shade out some of the shrub cover and return fire and fuel dynamics to those of the historic frequent fire forest.

Genetic Structure
Under the selected alternative, up to 20% of nonlocal genotypes will be introduced into a population during replanting. Since the remaining 80% of seedlings will be sourced from the genetic neighborhood and some of the genotypes and genetic structure of the original groves are retained through the natural regeneration, the risk of swamping (loss of genetic diversity currently existing in the population) is low (Aitken and Whitlock 2013) and is not expected to affect sequoia grove genetic structure. Retention of original grove genetic diversity and use of 80% locally sourced seedlings means that any unique phenotypes such as twisted bark—if any such trees were present and survived the fire—will likely be retained since most of the genetic material will still be local in origin and some natural regeneration has occurred and will continue to occur from any remaining live large sequoias in the groves.

Regardless of NPS action or inaction, the NPS anticipates that the genetic structure of the groves within the action areas will change in the future in response to immigration, emigration, and selection (Allendorf et al. 2007). There is little risk of the selected alternative negatively impacting population fitness as those individuals not adapted to future stressors will perish and fail to pass on their genes to the next generation.

<u>Fisher</u> – As documented in the EA and further documented in Section 7 consultation documents, potential temporary effects will be like those described for wildlife generally (see page 3). No long-term negative effects on fisher were identified and implementation of the selected alternative will not result in the impairment of fisher.

Rather, the selected alternative is expected to benefit fisher over a period of 50-100 years and beyond, by improving stand structure across the 485-acre fisher habitat corridor project area. Improving habitat value in this area will, in turn, facilitate fisher movement dispersal and associated gene flow vital to the species conservation and meet fisher habitat requirements for foraging, resting, denning, and predator avoidance.

<u>Visitor Use and Experience</u> –Temporary impacts to visitor use and experience attributed to project work are fully described under opportunities for solitude or primitive and unconfined recreation. In

summary, implementation of the selected alternative will not directly, indirectly, or cumulatively, cause impairment of visitor use and experience.

Wilderness Character – As documented in the EA, the selected alternative will result in temporary negative effects to several qualities of wilderness character within the action area and along helicopter flight paths; however, actions undertaken under the selected alternative will not directly, indirectly, or cumulatively result in impairment of this resource as further described below.

Untrammeled

The untrammeled quality will be negatively affected over an area up to 1,131 acres in wilderness for the first planting year. Should additional planting be necessary after the first year, trammeling will continue to occur in smaller portions of the action area each year planting is completed for a period of up to a total of approximately five to six years (estimated at one to two times per grove following the initial planting). The degree of short-term trammeling actions will be greater under the selected alternative when compared to Alternative 3 due to the introduction of non-local genetic material in seedlings grown from non-local seed sources which will result in a different genetic makeup than was present prior to the fire.

Trammeling actions will occur for the duration of the project while actions are actively being implemented. Once planting actions entirely cease (after approximately five to six years), the untrammeled quality will return to pre-project levels such that the untrammeled quality will be preserved in the long term. In summary, the selected alternative will not directly, indirectly, or cumulatively, result in the impairment of the untrammeled quality.

Natural

The selected alternative will restore the natural quality of wilderness character diminished by the loss of sequoias, an identified attribute of natural quality of the Sequoia-Kings Canyon and John Krebs Wildernesses, from nearly 750 acres of these wildernesses. As outlined in the revised EA on pages 67-68, while speculative, seedlings propagated from a variety of sources under the selected alternative may demonstrate increased survival capacity, increasing the likelihood of success and long-term resilience to climate change.

Likewise, should seedlings grown from other sources prove key to successful replanting of these areas, this alternative will beneficially affect natural quality of wilderness character to a greater degree than Alternatives 1 and 3; though the characteristics of the population will be different from what will otherwise be present. In sum, the selected alternative will not directly, indirectly, or cumulatively result in the impairment of natural quality, rather is expected to eventually result in the restoration of currently diminished natural quality.

Undeveloped

Installations of up to 600 small plot markers and 60 other installations across the action area to monitor vegetation and other resources within areas that burned at high severity will temporarily and negatively influence undeveloped quality for at least 30-40 years until such installations are removed.

The undeveloped quality will also be negatively affected by up to six sling-load helicopter deliveries and roughly two to three hours of chainsaw use (when determined necessary) at each planting location the first year of planting, and up to one to two sling-load deliveries during each subsequent planting (estimated as one to two per planting location over the next five to six years) (see Table 3 on page 35 of the EA). The negative effects on undeveloped quality from motorized tool use and transport will return to pre-project levels once those tools are no longer being used.

If chainsaws, rather than explosives, are used to fell snags, evidence of up to ten cut stumps per delivery location will result in additional, though minimal, negative effects on undeveloped quality until stumps deteriorate naturally—a period of typically 10-20 years, depending on stump diameter and tree species. The small tree wells created around each seedling will likewise have a minor, though negative, effect on undeveloped quality until the wells are no longer evident on the landscape—a period of one to two years post planting. Despite these temporary impacts to undeveloped quality, the undeveloped quality will return to pre-project condition once project actions cease, such that the undeveloped quality will not directly, indirectly, or cumulatively be impaired.

Opportunities for Solitude or Primitive and Unconfined Recreation

As described on page 69 of the EA, though primitive and unconfined recreation will not be affected by this project, opportunities for solitude will be negatively affected by the sights and sounds of up to roughly 37 helicopter flights traveling over wilderness for up to 30 minutes per flight to each location over the course of approximately five to six years. The use of chainsaws running for up to an estimated two to three hours at each location to potentially fell snags within the first year of planting will further negatively affect this quality. Where explosives are used to fell snags (instead of chainsaws), the impacts to this quality will be more intensive and far reaching, but of shorter duration—a period of seconds. Finally, the sights and sounds of mule strings (8 mules per string for a total of up to 98 strings in Redwood Mountain area only) and 10-15 tree planters will negatively affect solitude up to 2-3 weeks annually per area will temporarily and intermittently diminish opportunities for solitude over the course of up to a total five years.

Post project, opportunities for solitude or primitive and unconfined recreation will return to pre-project levels, and this quality will be preserved in the long term. In summary, implementation of the selected alternative will not result in direct, indirect, or cumulative impairment of this quality of wilderness character.

Summary

As described above, adverse effects and environmental impacts anticipated as a result of implementing the selected alternative on a resource or value whose conservation is necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the park, key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park, or identified as significant in the park, general management plan, or other relevant NPS planning documents, will not rise to levels that will constitute impairment of park values and resources in Sequoia and Kings Canyon National Parks.

In conclusion, as guided by this analysis, available science and scholarship, advice from subject matter experts and others who have relevant knowledge and experience, and the results of public involvement activities, the Superintendent has determined that there will be no impairment of park resources and values from implementation of the selected alternative.

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Appendix B: Response to Public Comments Received During Public Review

The National Park Service (NPS) received roughly 1,830 individual pieces of correspondence that were submitted through the project website and/or mail, as well as roughly 60 individual pieces of correspondence that were submitted via email, during the July 7 to August 6, 2023 public review period for the Environmental Assessment. Of the correspondence submitted via the project website, at least 1,158 were largely form letters.

While the NPS received many comments both in support of the proposal and in opposition to it, this document addresses substantive comments received,[2] as well as numerous other concerns raised, during the public review period and is organized into concern and response statements. Unless indicated within the text, all page numbers contained herein refer to the revised *Re-establish Tree Seedlings in Severely Burned Giant Sequoia Groves and Adjacent Fisher Habitat Environmental Assessment*.

A. Comments that Indicate a Misunderstanding of the NPS' Proposal

A1. Concern Statement: The NPS received hundreds of correspondences that voiced opposition to logging operations, clear-cutting, and/or plantation forestry. Other individuals indicated that special interests, including timber extraction companies, would benefit from the project.

Representative Quotes

"I am urging you to withdraw the proposal for tree plantations and clear cutting with the Giant Sequoia groves."

"Don't be just a division of the timber industry, as is USFS."

"I was shocked, to read that your agency, wants to eliminate forest, and wilderness areas, and implement a tree farm."

NPS Response

These comments appear to misunderstand the purpose of the project and the scope of the proposed action. Given that none of the alternatives, including the selected alternative, propose to 1) develop a tree plantation (which is generally considered a monoculture forest planted for the purpose of high volume wood production), 2) conduct logging, clear-cutting, or removal of fallen logs, 3) fell any trees other than up to roughly 10 snags (dead trees) in a limited number of locations only as necessary to ensure landing safety for sling-loads, or 4) result in direct economic benefit to any company or business involved in timber extraction, the NPS has determined that

[2] A substantive comment is defined by NPS Director's Order 12 (DO-12) as one that does one or more of the following: 1) question, with reasonable basis, the accuracy of information in the environmental analysis; 2) question, with reasonable basis, the adequacy of the environmental analysis; 3) present reasonable alternatives other than those presented in the environmental analysis; or 4) cause changes or revisions in the proposal. In other words, substantive comments raise, debate, or question a point of fact or analysis. Comments that merely support or oppose a proposal or that merely agree or disagree with NPS policy are not considered substantive and do not require a formal response; though the NPS has provided responses to some non-substantive comments where clarification may be helpful. The NPS must consider all comments that are timely received, and the standard NPS practice is to respond to substantive comments that are submitted during the public review period for EAs (46.305(a)(1)).

concerns raised by these comments are sufficiently addressed in the publicly released EA and no further response is necessary.

B. Comments Related to General Compliance with the National Environmental Policy Act or Administrative Procedures Act

B1. Concern Statement: Availability of Field Data. One commenter asked the NPS for a number of pieces of information, including field data, throughout and following the public review period of the EA and stated this information should be shared with the public as it impacts the NPS' decision. At least two commenters indicated that NEPA had been violated because the NPS had not provided them requested data. One other commenter requested a printed copy of the EA and suggested ways for the NPS to share paper copies with the public.

Representative Quotes

"…The Park does not get to turn sequoia groves in Wilderness Areas into tree plantations, and irrevocably alter the genetics of the groves with seedlings from other grove areas, based on secret data that is withheld from the public…Nor is the Park empowered to make the public guess about the numerical sequoia seedling density threshold that you are using to determine whether or not you intend to create a tree plantation in a given area…and nowhere does the EA actually state the numerical sequoia seedling density threshold that you plan to use to make the decision to plant or not plant in any given area under your decision tree (Fig. 7 of the EA)."

"…The CEQ regulations state that, to comply with NEPA, an agency "must insure that environmental information is available to public officials and citizens before decisions are made and before actions are taken. The information must be of high quality. Accurate scientific analysis, expert agency comments, and public scrutiny are essential to implementing NEPA." 40 C.F.R. § 1500.1(b). To fulfill NEPA's public disclosure requirements, the agency must provide to the public "the underlying environmental data" from which the [agency] develops its opinions and arrives at its decisions."

"I am once again respectfully requesting the following information in order to be able to meaningfully comment on the EA: 1: The plot coordinates and sequoia seedling density data for each plot conducted by the Park in June 2023 in the Redwood Mtn. Grove, Board Camp Grove, and the 485-acre fisher area. 2: The numerical sequoia reproduction density threshold below which the Park claims there is insufficient sequoia reproduction (from some of the passages on pp. 3-6 of the EA, I could perhaps infer what the Park's asserted numerical seedling density threshold is, if I were to make an assumption or two, but I do not want to make assumptions, and there is a wide disparity between Stephenson et al. 2023 and York et al. 2013 (Figure 2) in terms of the year-two post-fire sequoia seedling density, and the progression of that density over time, so please clarify what that numerical threshold is, if you don't mind--thanks). 3: Maps showing specifically where the Park claims sequoia reproduction is insufficient based on 2023 surveys (the "portions" of the high-severity fire areas referenced on p. 27 of the EA), and where the Park asserts that planting is needed/planned, within the high-severity fire areas of the Redwood Mtn. Grove, Board Camp Grove, and the 485-acre mixed-conifer fisher area."

"This is why I am requesting this information--in order to understand what the Park is actually proposing to do where, and what the scientific basis is for any assumptions or conclusions made. So, I am once again respectfully requesting the following information in order to be able to meaningfully comment on the EA"

"…it would be an egregious violation of NEPA to conceal these data and refuse to provide them to me and other members of the interested public.…"

"…Park staff, and the experts upon whom the Park is relying, refused to provide these data for the public to evaluate, scrutinize and ground-truth during the comment period, even as Park staff made clear that they were relying centrally on the Park's 2023 data for the decision to plant trees…"

"…Furthermore, the NPS does not believe that this data is necessary for informing the decision at hand (i.e., whether or not to select an alternative outlined in the EA, or modification of an alternative, for implementation).'] is directly contradicted by the EA, which states on p. 27 (and elsewhere) that (a) the Park will base its decision on whether to plant in a given area on results of 2023 field surveys, (b) those 2023 field surveys have already been completed in the Redwood Mountain Grove, the 485-acre mixed-conifer area next to the Redwood Mountain Grove, and the Board Camp Grove in mid-June 2023, and (c) the numerical results of those surveys have led the Park to conclude that "action [planting] is necessary to avoid loss of portions of these sequoia groves and mixed conifer forests" in Redwood Mountain Grove, the 485-acre mixed-conifer area, and Board Camp Grove. Therefore, by the EA's own explicit description, the EA is relying fundamentally on these mid-June 2023 field data for its decision to plant in these areas, yet the results of those data are nowhere presented in the EA, and now the Park is refusing to divulge the very information upon which your central conclusions and decision to act is based."

NPS Response
According to the NPS NEPA Handbook, "incorporated material must be "reasonably available for inspection by potentially interested persons within the time allowed for comment" on the NEPA document (1502.21)" (NPS 2015, p 25). Information on which the NPS is relying upon for a decision related to in the EA is, and has been, publicly available since before initiating public review of the EA. Specifically, Stephenson et al. 2023 (in preparation) and Soderberg et al. 2023 (in review) (as well as the underlying data and plot coordinates)—on which the NPS relies to inform the decision tree outlined in the action alternatives in the EA—have been publicly available since early June 2023, if not earlier (despite the disclaimer in Soderberg et al. 2023 (in review), the data were reviewed and released in May). The NPS also attached these U.S. Geological Survey (USGS) peer reviewed papers and links to the papers and data online (https://parkplanning.nps.gov/ReEstablishGiantSequoiaPostFire2021) on July 14, 2023, in the same location as the EA, for the general public to more readily access during the public review period. A link to the data was shared directly with the commenter on July 22, 2023.

In addition to the aforementioned information, the methods, plot sizes, and plot numbers for the *regeneration surveys*—as requested by the commenter—are outlined in Soderberg et al. 2023 (in review). The study design was developed by USGS following principles of a randomized spatially-balanced survey design, and the USGS data release that accompanied the release of Soderberg et al. 2023 (in review) includes the data, plot locations, timing of survey, and other information associated with plots that were surveyed by partner crews from University of California, Davis (UC Davis) under a cooperative agreement with NPS in Redwood Mountain Grove (46 plots) and Board Camp Grove (20 plots) in 2022. The NPS clarified for the commenter that 2023 data from surveys in Redwood Mountain Grove were collected from all 46 plots again in early summer 2023 with the same plot diameters at the same locations, using the same methods.

Despite the availability of this information, this same commenter requested specific NPS field data of sequoia regeneration surveys (e.g., the mean and median values of the plot data and associated maps) completed within Board Camp Grove, Redwood Mountain Grove, and the 485-acre fisher area in 2023. The NPS did not provide 2023 regeneration data to the commenter for the reasons outlined below (which were also explained to the commenter during and following the public review period).

The regeneration data from field surveys is not necessary to inform the decision of whether to select an alternative (or a variation thereof) outlined in the EA (i.e., approve a Finding of No Significant Impact (FONSI)). As the EA outlines, the NPS would apply a decision tree if one of the action alternatives is selected for implementation to evaluate whether or not to monitor only, or to both plant and monitor within some or all of the seven potential action areas. As evident on pages 20-30 of the revised EA, this decision tree is based on (1) a RAVG analysis to identify areas of potential regeneration failure, (2) field surveys of reproductive potential, and (3) field surveys of regeneration. Under the action alternatives, if there are large patches of high severity fire effects present, contiguous areas without living reproductive trees, and if seedling density has less than a 90% probability of achieving the Bayesian estimated mean of 16,011 seedlings per acre reference density (14,112 sample mean density) two years post fire identified in Stephenson et al. 2023 (has undergone USGS peer-review, in prep for journal submission), the NPS would plant and monitor in the area. If any of these conditions do not apply, the NPS would monitor; no planting would occur.

Because the EA, with additional detail provided in the revised EA, analyzes the full range of direct, indirect, and cumulative environmental consequences from the potential to simply monitor and/or plant and monitor (i.e., the range of potential actions following the application of the decision tree) across the entirety of all seven potential action areas, and the requested field data does not inform the evaluation or assessment of environmental consequences in the EA, the specific field data to inform the decision tree outlined in the action alternatives are not necessary to determine whether or not a FONSI is appropriate.

The other reason for not releasing the field data collected in 2023 in Redwood Mountain Grove and the 485-acre fisher area during the public review period is that the data had not been QA/QC'd (quality assured/quality controlled) at the time. NPS and cooperator data are governed by the Department of Interior Information Quality Guidelines, a set of policies and regulations designed to ensure that quality data is provided in a transparent and scientifically valid manner in a reasonable timeframe, and the NPS was not in a position to proactively release the data until September 2023. The NPS also responded to the commenter directly and clarified that the only field data for Board Camp Grove was completed in 2022 (which was released to the public prior to the public review period) and provided that densities were exceptionally low, and no year two seedlings (i.e., no new germinants) were detected. The NPS also clarified in the revised EA that this field data was not collected *in* June 2023.

All said, because field surveys were being completed concurrent with the NEPA planning process and, out of a desire to be as transparent as possible, the EA references the findings from field surveys that had already been completed at two groves and within the fisher habitat area, and the NPS provided the sampled and estimated mean values and probabilities from the results of the field surveys (with the caveat that these numbers were preliminary and the data had not been QA/QC'd) in the virtual public meeting held during the public review period of the EA on July 25, 2023. A recording of this public meeting was made publicly available on August 2, 2023. Again, the NPS provided these initial estimated mean values to illustrate how the NPS staff were continuing to collect data and that this data was not showing trends that alleviated the NPS' concerns regarding sequoia seedling densities. In short, the NPS has released all information and data that could be released to the public during the planning process, as well as all that which informed NPS' assumptions in the EA.

In addition, because the decision tree within the selected alternative inherently dictates that future, tiered decisions with regards to implementation will be needed (i.e., to implement planting or implement monitoring, alone), the NPS will share regeneration data from each area and the findings of each area's decision tree on the parks' Planning, Environment, and Public Comment website (the website where the EA is posted), and will do so prior to implementation if the decision tree indicates regeneration may not be sufficient.

It also bears noting that many of the planting/restoration proposals/projects that the NPS is aware of do not typically include rigorous studies of onsite regeneration. This is true even in Sequoia and Kings Canyon National Parks where facilities within Giant Forest Grove were removed over twenty years ago and the NPS planted giant sequoias and other conifers in previously disturbed areas to foster restoration within the grove. In practicing restraint and in an effort to limit action within wilderness, the NPS has applied a rigorous scientific method to understand regeneration prior to taking action, and while the NPS considered compiling, reviewing, and analyzing all survey data prior to finalizing a proposed action, the agency determined that doing so would be counter to the purpose and need for action and would not result in a better understanding of potential impacts; if anything, a piecemeal approach may have hindered that analysis.

As the NPS discusses in the EA (pages 2 and 43-44), based on sequoia ecology and other studies of fire-driven vegetation type conversion, the NPS finds that there is an urgency to act to restore seedlings to these areas if regeneration does not show a high probability of aligning with reference densities. Due to the time needed to gather the regeneration surveys, conduct analyses, prepare an environmental analysis, and provide ample public involvement, the agency determined that it was more feasible, transparent, and ultimately in better alignment with federal resource protection laws to present a proposed action that lays out the full potential for action (via a decision-tree) and analyze the complete direct, indirect, and cumulative impacts of intervening in each area rather than wait to collect and analyze the field data and then scale back the action areas and analyses if appropriate. Notably, planting immediately post-fire would have been the best conditions under which to plant; in some areas considered for planting, the fire occurred already three years ago. Under the current approach, the public can see the full impact of the proposed actions should data show that planting is necessary. And as stated above, the NPS has released the data collected so far so that the public would not be surprised by what the NPS is observing on the ground and the likely need for intervention in many of these areas.

On a final note, the NPS mailed a copy of the EA to the member of the public that requested it and responded directly to the commenter during the public review period regarding their questions about the threshold below which the NPS believes there is insufficient sequoia reproduction. The NPS further addresses these questions in response to Concern Statement E2 and within the revised EA.

B2. Concern Statement: Public Access. Many commenters, whose comments were largely identical, requested that the NPS allow public access to Redwood Mountain Grove as well as access for researchers and the press in order to "assess the accuracy of the government agency's representations in an EA or EIS regarding on-the-ground conditions before decisions are made about the areas in question" and the right of access to public lands under the First Amendment of the U.S. Constitution.

Representative Quote
"The Park's closure of the Redwood Mountain Grove to the public and press during the 30-day comment period on the planting proposal Environmental Assessment--an action which precludes

the ability of the public and press to visit the areas proposed for planting and see for themselves whether the Park's claim that there is a lack of sequoia seedlings in such areas is true after the past winter. The public and press have a First Amendment right to access these areas, especially for the purposes of assessing whether the Park's claim that sequoia reproduction is lacking is true."

"Cancel the Redwood Mountain Grove closure order and allow the public and the press to access the higher-intensity fire areas, take photos and video, and decide for themselves whether SEKI's claim that these areas lack sequoia seedlings is credible."

"The rights of site access that I am referencing here…pertain to: (a) the right of the interested public, during the NEPA public comment period, to assess the accuracy of the government agency's representations in an EA or EIS regarding on-the-ground conditions before decisions are made about the areas in question; and (b) the right of access to public lands, subject to narrow restrictions for clear, specific, and compelling reasons, under the First Amendment of the U.S. Constitution. With regard to the latter right, public land agencies violate the First Amendment when they close entire areas and deny the public and the press the opportunity to visit areas in question and scrutinize management proposals and actions of the land agencies. The public and the press have a right to access public lands, especially in the context of a controversial government proposal in which there is an important public need to gather on-the-ground evidence and photo documentation to investigate the veracity of the government's representations…The current Redwood Mtn. grove closure is the very type of closure that the federal courts have found to represent a violation of the First Amendment...."

NPS Response

The Redwood Mountain Road, Sugar Bowl Trail, Hart Tree Trail, and Redwood Canyon Trail (all of which lead to or through Redwood Mountain Grove, a portion of the project area) have been closed to the public under the authority provided to the Superintendent in 36 CFR 1.5 since the KNP Complex Fire in 2021 as significant hazards remain (falling trees and branches, burned out holes, lack of route finding, rolling rocks, mud and debris flows, etc.). However, given the substantial interest expressed by the public in accessing this area, the NPS developed a process to accommodate public access while mitigating identified risks; this process was developed within five days of the initial request for public access. This process—which includes a simple email request to the park for access and the near-immediate transmittal of an authorization letter for access—enabled the NPS to communicate hazards (like tree fall and difficult route-finding conditions), identify conditions as to prevent resource damage (like not trampling seedlings when off trail), and provide recommended actions used by park staff to reduce risk while in the closure. As of September 25, 2023, the NPS had received and authorized requests for access from a total of nine members of the public. Commenters were also encouraged to visit any other portion of the proposed action area as those areas have remained open.

The NPS scheduled two public site visits and one tribal site visit to the area during the public review period for the EA and invited the public and tribes to join NPS staff onsite to discuss the EA during that time. Site visit dates and a link to the PEPC website, where information on how to sign up for the site visits was posted, were communicated to the public via a press release at the time the EA was released. Roughly 13 members of the public contacted the NPS to join these site visits, and the NPS was able to accommodate all their requests; 10 members of the public ultimately attended one of the two scheduled site visits. Researchers, including one of the commenters, have also retained access to these areas through research permits, and the NPS communicated through responses to commenters that the press was encouraged to coordinate with the parks' public affairs office so the NPS could appropriately accommodate their access.

B3. Concern Statement: Extend Comment Period. Two commenters requested that the NPS extend the public comment period so that they could visit Redwood Mountain Grove and independently verify information provided in the EA. After the public review period ended, one of these commenters also requested the park's superintendent delay a decision on the EA to enable this same request.

Representative Quotes

"I am respectfully requesting that the Park please extend the public comment period for the EA by an additional 30 days, or use some other means to extend the public process, such as preparing a supplemental EA (given new information and changed circumstances) or withdrawing the EA and preparing an EIS. This will give our research team and others time to assess the actual on-the-ground conditions in terms of sequoia and mixed-conifer seedling densities in the areas currently proposed for planting, based on outdated field data from previous years and undisclosed data from mid-June 2023."

"…The public must…be able to ground truth the Park's field plots and compare the Park's data for each plot to independent findings. There is a compelling need for this type of independent verification here, and such verification is only possible if the Park prepares an EIS or extends the EA comment period."

"…if you do intend to proceed with the proposal, the public needs much more time to assess the on-the-ground conditions and document the disparity between the Park's claims and the on-the-ground reality."

NPS Response

There are many reasons an agency might extend a public comment period for an EA, usually as it relates to errors in the issuance of the EA that impact the ability to submit comments. As shared with the commenter, their rationale for an extension was not germane to an evaluation of the EA's alternatives (as explained further in response to Concern Statements B1 and C7) and given the overall planning schedule and potential implementation schedule, extending the public comment period would, by nature, have potentially severe ramifications on the project if one of the action alternatives is selected for implementation. As outlined on page 2 in the revised EA, there is some urgency behind taking action, and the Superintendent expressed directly to the commenter that he did not feel that the NPS would be practicing responsible stewardship of these lands and their resources by extending the public comment period without additional justification.

B4. Concern Statement: Pre-decisional. Several commenters stated or suggested that the NPS violated NEPA by reaching decisions to complete surveys, collect cones, and determine that planting will occur within Board Camp Grove, Redwood Mountain Grove, and a 485-acre fisher proposed critical habitat corridor without documentation of the impacts or prior to a FONSI.

Representative Quotes

"…Park staff made clear that they were relying centrally on the Park's 2023 data for the decision to plant trees—a decision that Park staff indicated they had already made well before the end of the public comment period and before comments and submitted evidence had been considered (see Appendix 2, attached). This is a violation of NEPA."

"The research damage and the sequoia cone gathering have also violated NEPA because there is no documented analyses of the impacts from these activities prior to implementation."

NPS Response
The actions the commenters reference have not been implemented without review and documentation of compliance with federal resource protection laws.

Concerning the references to conducting surveys and collecting cones in the project areas, the NPS has documented environmental impacts via a categorical exclusion (associated with nondestructive data collection and inventory) for plant surveys as well as issuing research permits to enable others to study the area, and mitigations were developed to protect seedlings during those activities (see also response to Concern Statement G2). Similarly, through a lengthy footnote on pages 30-31, the revised EA explains how the NPS complied with the National Environmental Policy Act for cone collection activities that preceded a FONSI, and these actions were included within the cumulative impacts analysis in the EA.

Concerning references to making the decision to replant, the NPS has not made any decisions about the proposed action prior to the completion of the EA and issuance of a FONSI. While the commenter referenced an email exchange between NPS staff and the commenter as evidence of this perception, the NPS did not find any language in in the correspondence suggestive that a decision had been made prior to a FONSI.

B5. Concern Statement: Tribal Consultation. Several commenters suggested that indigenous people should be consulted for their knowledge prior to determining action. One commenter suggested the project does not align with indigenous values.

NPS Response
The NPS consulted with tribal partners during the scoping and EA public review phases and has continued consultation with tribes since that time. This consultation process and the feedback received thus far are described in Chapter 4 in the revised EA.

C. Comments Related to the NEPA Pathway and Adequacy of the Environmental Analysis

Several commenters stated that the NPS needed to prepare either a supplemental EA or an EIS for a number of reasons which are addressed individually below.

C1. Concern Statement: Precedent Setting. Several commenters stated that the NPS needs to prepare an EIS because the actions are "precedential" or "precedent setting."

Representative Quote
"…we know of no previous proposal that would plant trees, essentially creating plantations, in a NP Wilderness. Therefore, the proposed action would establish a precedent for future actions with the associated significant ecological effects (beneficial and adverse); so would the adverse effects from frequent use of helicopters and chainsaws in Wilderness. For those reasons alone, an EIS is necessary, because there the Park Service will likely use this action as a precedent to propose similar post-fire planting in other Wilderness areas affected by climate change."

NPS Response
The action alternatives considered in the EA may be considered unique in that they represent a response to an unprecedented situation—where large contiguous areas of high severity fire burned through sequoia groves of the Sierra Nevada (see Appendix C of the EA for a discussion on the situation and its relationship to climate change), and if planting in any of the sequoia groves is indeed implemented, it will be the first time sequoia seedlings are planted within wilderness in

these parks. However, these factors do not make the action alternatives "precedent setting" as planting mixed conifer tree seedlings in wilderness, is not unprecedented, nor is planting sequoia seedings in existing groves or within their range.

Vegetative restoration, including post-fire planting of tree seedlings, is common practice on public lands throughout the United States (including federal lands managed by the NPS), as are actions introducing non-local genetic material in the case of re-introducing or augmenting genetic resources. There are also a number of examples of planting sequoias and mixed conifer seedlings across the Sierra Nevada, including within Sequoia and Kings Canyon National Parks (see footnote on page 30 of EA). Similarly, the use of helicopters and chainsaws in wilderness—when determined to be the minimum tools for a necessary action in wilderness—is not precedent setting in Sequoia and Kings Canyon National Parks as described in the EA (page 64) and the parks Wilderness Stewardship Plan (NPS 2015). Post-fire planting of tree seedlings is not the equivalent of creating a plantation, as suggested by several commenters. In summary, the nature of the proposed action (planting post disturbance) and its components (collecting cones, surveying seedlings, hiking, camping, cutting snags with explosives or chainsaws, transporting equipment and material via stock and helicopter, planting by hand, and monitoring) are not precedent setting. They are representative of actions that are typically approved by the NPS under a categorical exclusion.

Furthermore, current Council on Environmental Quality regulations concerning the National Environmental Policy Act do not require preparation of an EIS for actions that are simply precedent setting (see 40 CFR Parts 1501.3-6 and 1502), and the NPS's NEPA Handbook does not identify precedent setting as one of the "circumstances that indicate an EIS is the appropriate NEPA pathway" (NPS 2015, p 18). Rather, an EIS is applicable to proposals that could result in significant adverse environmental impacts. Concerns related to the potential for significant impacts are addressed in response to Concern Statement C4.

C2. Concern Statement: Controversy. At least one commenter stated that the NPS needs to prepare an EIS because "the actions are highly controversial," specifically as they relate to impacts to wilderness.

Representative Quote

"Here, there has already been a significant scientific dispute as to whether the actions are necessary and at what level of density of natural sequoia regeneration planting should take place…Moreover, the term "controversial" also "refers to cases where a substantial dispute exists as to the nature of the environmental consequences of a proposed action. Because the action is proposed in Wilderness, NEPA requires a more thorough analysis in an EIS because the substantive restrictions in the Wilderness Act that preclude the types of actions proposed here." That is especially so where the proposed action will have a negative impact on the Park's Wilderness character and involve activities prohibited by the Act, including mechanical transport (helicopters), motorized equipment (helicopters and chainsaws), and ecological manipulation."

NPS Response

The term "controversial" under NEPA has long been understood to refer to cases where a "*substantial dispute exists as to the nature of the environmental consequences of a proposed action*" [emphasis added] (NPS 2015, p 21). Consultations with subject matter experts, review of the body of peer-reviewed publications, consulted agencies, and even assessment of the comments received during public review, do not demonstrate substantial controversy *as to the nature of the environmental consequences* of the evaluated alternatives within the EA. Importantly, with the 2020 revisions to the CEQ NEPA regulations, the concept of controversy is no longer a factor when determining whether the effects of an action are significant, and therefore whether an EIS must be prepared. As explained in the preamble to the 2020 regulations, "…the extent to which effects may be controversial is subjective and is not dispositive of effects' significance. Further, courts have interpreted controversy to mean scientific controversy, which the final rule addresses within the definition of effects, as the strength of the science informs whether an effect is reasonably foreseeable. The controversial nature of a project is not relevant to assessing its significance" (FR 85 43322). The NPS has acknowledged in the EA, the beneficial and adverse impacts that would occur to Wilderness character under each alternative, and for the reasons stated in the FONSI, has determined that implementation of the selected alternative will not result in significant adverse impacts to Wilderness character or other resources. Therefore, an EIS is not required.

Notably, several comments on the EA pointed out that some details concerning environmental consequences had been overlooked or not fully explained. These comments are addressed in Concern Statement C4, Section G, and/or are further described in the revised EA, and demonstrate that there is no substantial dispute regarding the nature of the environmental effects from the project. Additionally, many commenters implied or directly voiced outrage about some of the impacts and the nature of those impacts, particularly to wilderness character, but did not refute the findings of those impacts with additional analysis that questions the intensity or context of the impacts. The NPS addresses these concerns about the Wilderness Act and impacts to wilderness character in Sections D and G. And a few commenters either shared unsupported opinions or analysis (no references cited) which do not rise to the level of a substantial dispute as to the nature of the environmental consequences, or focuses, not on the environmental consequences, but rather disputes "whether the actions are necessary and at what level of density of natural sequoia regeneration planting should take place." The NPS addresses these concerns about purpose and need and the scientific underpinnings of determining that need in Concern Statements, Section E.

Ultimately, though the NPS found it necessary to provide further context and detail for its impacts analyses via the revised EA, no substantive comments were provided that questioned, *with reasonable basis, a high degree of controversy as to the nature of the environmental consequences*.

C3. Concern Statement: Hard Look. Several commenters stated that the NPS needs to prepare an EIS because the NPS has not adequately considered environmental impacts (e.g., had failed to take a "hard look.")

Representative Quote
"The environmental impacts of the proposed planting effort regarding disturbances and stress to wildlife and habitat, due to human and mechanical intrusion, and noise, from helicopters, explosives, chainsaws, mule trains, work crews camping in the forest for up to two weeks at a time, etc., have not been adequately considered. The same applies to the potential for contamination by invasive plants, pathogens, and genetic contamination of nursery seedlings, equipment, and other intrusion. At the very least there should be full environmental impact statements to consider these and other potential impacts in greater depth."

"Moreover, NEPA requires the agency to take a hard look; at the potential environmental effects of the proposed action and alternatives. A proposal that would essentially create plantations of sequoias and other trees in the SEKI, the John Krebs, and proposed Wilderness most certainly triggers these factors and requires preparation of an EIS."

NPS Response
The NPS has considered impacts to all resources identified by NPS staff, consulting agencies, and the public during two public scoping periods and the public review period for the EA. The EA, together with additional details in the revised EA, considers all foreseeable direct, indirect, and

cumulative impacts, uses sound science and best available information, and makes a logical, rational connection between the facts presented and the conclusions drawn. The NPS complied with NEPA and has taken the required "hard look."

C4. Concern Statement: Significant Impacts. Several commenters stated that the NPS needs to prepare an EIS because the impacts of the proposed action would be significant or would be cumulatively significant given other past, present, and reasonably foreseeable actions, and one commenter identified two other actions that are occurring within the Sequoia-Kings and John Krebs Wildernesses but are outside the potential action areas. One commenter specifically raised the concern that adverse effects may still be present despite beneficial effects.

Representative Quotes

"Impacts that may be both beneficial and adverse. A significant impact may exist even if the federal agency believes that on balance the effect will be beneficial. Here, planting trees in the context of Wilderness is both adverse and beneficial. While the actions proposed would adversely affect Wilderness characteristics of untrammeled, natural, undeveloped, and solitude…the Park Service's EA effuses the many benefits the proposal would bring in restoring the groves. These potential adverse or beneficial effects, in light of their precedential nature of planting in Wilderness, the highly controversial and uncertain effects from planting, require that the Park Service analyze the project with an EIS."

"In our scoping comments, we specifically included two other actions the Park Service is implementing in the SEKI Wilderness, including its roadside hazard project, which would chainsaw fell large trees within the Wilderness at a certain distance from roads, and the Wilderness chainsaw and tree cutting in Wilderness groves…Ironically, while the cumulative effects analysis in the Wilderness effects section discusses the Fire and Fuels Management Plan, which the Park Service violates in its Emergency Actions in unburned groves…, there is no mention of these projects in the EA, even though the activities are concurrent and would adversely and cumulatively affect Wilderness character."

NPS Response

One of the "circumstances that indicate an EIS is the appropriate NEPA pathway" is when "the proposal is expected to or has the potential to result in significant *adverse* environmental impacts" (NPS 2015, p 18, emphasis added). The EA was written and reviewed in consultation with resource and environmental compliance specialists (the full Interdisciplinary Team and their expertise is listed in Chapter 4 of the EA), and conclusions therein are either supported by NPS expert opinion or peer reviewed literature cited throughout the document.

In response to concerns raised during the public review period over the degree of impact and cumulative effects described in the EA, the NPS re-evaluated the description of the affected environment, direct and indirect effects, and cumulative effects, including both those that are beneficial and those that are adverse. As a result of this review, the NPS determined that some clarifications and additions (including reference to influences from tree hazard management and emergency fuels reductions in sequoia groves) were appropriate in either the affected environment or effects sections and those were provided in the revised EA. (See also the responses to Concern Statements in Section G.) Taken as a whole, and through the full record of NEPA documentation, the NPS has affirmed that in consideration of both the context and intensity of the action, including cumulative effects, a FONSI is supported. Please see the FONSI for the full discussion and rationale behind a "finding of no significant impact."

C5. Concern Statement: Impacts to Wilderness and Ecologically Critical Areas. One commenter stated that the NPS needs to prepare an EIS because the actions will affect wilderness and other ecologically critical areas (i.e., fisher proposed critical habitat).

Representative Quote
"While all actions in National Parks affect unique characteristics, here the actions are being proposed in Wilderness and ecologically critical areas, including habitat for the Pacific fisher, a species listed under the ESA as endangered. Again, this factor suggests preparation of an EIS."

NPS Response
The NPS fully evaluated impacts to both wilderness and fisher habitat within the revised EA and identified no significant impacts that would require the preparation of an EIS. Outside of potentially having significant effects, the National Park Service's NEPA Handbook does not identify the potential to impact wilderness areas or ecologically critical areas as one of the "circumstances that indicate an EIS is the appropriate NEPA pathway" (NPS 2015, p 18).[3] In other words, simply because an action may affect wilderness or ecologically critical areas does not, on its own, require an agency to prepare an EIS.

C6. Concern Statement: Uncertainty. A group of commenters stated that the NPS needs to prepare an EIS because the outcome of the action is uncertain. Some commenters specifically suggest that there is uncertainty related to impacts to soils and vegetation, fisher and fisher habitat, the genetic makeup of sequoia groves, and wilderness.

Representative Quote
"The degree to which the potential impacts are highly uncertain or involve unique or unknown risks. This factor involves high levels of uncertainty and risks that are unique or unknown, which would make it difficult or impossible to reasonably predict impacts of an action, which require analysis in an EIS. Here, the EA and associated analysis admits the highly uncertain outcome of the planting, in that it may take up to 6 seasons of planting seedling for the there to be sufficient numbers of surviving trees, and even then the outcome is highly uncertain. Moreover, the impacts from the planting itself in the form of boots on the ground, the digging holes for each of the tens of thousands of seedlings in an area with highly-disturbed and fragile soils is highly uncertain and involves unique and unknown risks. The risks are unique because this is the first such actions that we know of in NP Wilderness, and there are many unknown risks, such as the long-term adverse effects on soil and vegetation in burned sequoia groves, the long-term genetic makeup of planted groves from sources outside the groves, and the impact to areas outside groves where planting is proposed in endangered Pacific fisher habitat. These effects and the outcome will be uncertain for decades or even longer. Moreover, the continued and highly uncertain effects from climate change also requires a more thorough analysis in an EIS."

NPS Response
The current CEQ regulations for implementing NEPA do not require the preparation of an EIS when uncertainty of environmental consequences exist. That said, the proposed CEQ regulations under current review recommend including "The degree to which the potential effects on the human

[3] Department of Interior regulations concerning the National Environmental Policy Act require agencies to prepare an *EA or EIS* if an "extraordinary circumstance" applies to a proposed action which could otherwise be "categorically excluded" from further analysis under NEPA (46.205(c)). One of these extraordinary circumstances is if the action may "have significant impacts on such natural resources and unique geographic characteristics as…wilderness areas…and other ecologically significant or critical areas" (NPS 2015, p 40).

environment are highly uncertain" [emphasis added] as a factor for considering whether or not an EIS is appropriate (CEQ 2023).

The revised EA, with incorporation of clarifications and additional detail provided in response to public comment, outlines the full range of potential environmental consequences that the NPS anticipates could follow from implementation of the alternatives considered in the EA, including the potential for implementation to extend for 5-6 years (across two plantings in each area) and the variability of outcomes that are anticipated, as the commenter highlights. Although the precise outcome of any of the action alternatives is uncertain as it is with any planting or restoration work or—for that matter—any effort that extends for some time into the future (e.g., the precise number of holes that will be dug for each planting and the number of seedlings that will survive), the EA discusses the full range of those impacts, including those to soils and vegetation, fisher and fisher habitat, the genetic makeup of sequoia groves, and wilderness, as well as a number of other resources. Through this analysis and in reading through public comments, the NPS did not find any evidence to suggest that there is a high degree of uncertainty beyond the range of impacts that are outlined within the EA.

This conclusion is further validated by a long history of planting across the United States and within the Sierra Nevada in particular. As mentioned in response to Concern Statement C1, trees have been planted across the Sierra Nevada for decades, and tree planting has occurred within wilderness in states including New Mexico, California, and Colorado, with no evidence suggesting substantive uncertain impacts. Meyer and Safford (2011) studied all areas they could find where sequoias were planted or grew naturally after fire decades ago. Sierra Pacific Industries has planted sequoias all over in California in tree plantations. The NPS itself planted sequoias within Sequoia National Park over 20 years ago after removing a large amount of infrastructure within Giant Forest Grove, and this area is not so ecologically disparate from the areas considered for planting in this plan, even those that are within wilderness, that would suggest uncertainty in impacts that cannot otherwise be anticipated. Despite this long history of similar actions, no one has reported any signs of novel disease or other substantial problems that would suggest uncertainty in the impacts of this action should the full scope of planting be implemented. As planting, even post fire, is an activity that has been implemented across the country and particularly within the Sierra Nevada, the NPS had examples of projects to review for guidance to understand scope of work and the environmental consequences. In the course of reviewing examples, and considering the scope of this project, the NPS has not identified uncertain impacts not otherwise identified with the EA.

C7. Concern Statement: Additional Analyses. A few commenters requested additional data and/or analyses. One commenter requested that the NPS complete a hydrology study, while another requested a genetic analysis of sequoia groves. Another commenter asked the NPS to prepare a supplemental EA or EIS to gather more data and complete more analyses related to field surveys of sequoia regeneration. As part of this request, the commenter specifically stated that field surveys need to be ground-truthed by independent scientists.

Representative Quote

"The study states that any attempt to avoid such serious genetic risks and impacts must be based on an extensive study and assessment: "To weigh the risks of AGF…we need to know the species' extent of local adaptation to climate and other environmental factors, as well as its pattern of gene flow." None of this extensive required assessment and analysis, including the extent and length of genetic isolation of the groves from each other and the level of gene flow, is analyzed or divulged in the EA, and there is no indication that this essential analysis has been conducted at all."

“Based on the following, we urge you to withdraw this proposal, at least for now, or at a minimum prepare an Environmental Impact Statement to: (a) give the public and independent scientists time to ground truth the Park’s 2023 field plot sequoia regeneration data, which has not yet been provided by the Park; (b) more carefully consider the discrepancies between the EA’s stated planting threshold regarding sequoia seedling densities and the reference given by the EA (Stephenson et al. 2023) as the source of this threshold; (c) properly assess the disparity between the EA’s core assumptions and predictions—i.e., that most (approximately 80% or more) of the year one post-fire sequoia regeneration would die by year two post-fire and that there would be little or no additional year two post-fire sequoia seedlings—and the actual results of 2023 field surveys; (d) allow time to see if year three post- fire data (and year four post-fire data in Board Camp Grove) continues to show substantially more positive results than the EA’s assumptions and predictions regarding sequoia seedling survival and new sequoia reproduction; and (e) adequately analyze new, emerging scientific research by independent scientists from the high-severity fire areas in Redwood Mountain Grove (research which includes data and metrics that are not part of the Park’s field surveys), and research from high-severity fire areas at 6 years post-fire in the Nelder Sequoia Grove, especially the finding that sequoia reproduction is higher in areas with the highest shrub cover, and the finding that young sequoias are densest and growing by far the fastest in the high-severity fire areas.”

“The rights of site access that I am referencing here…pertain to: (a) the right of the interested public, during the NEPA public comment period, to assess the accuracy of the government agency's representations in an EA or EIS regarding on-the-ground conditions before decisions are made about the areas in question.“

“The unprecedented nature of this proposal, the controversy and unknown genetic risks from planting sequoia seedlings from completely different groves from different areas, the massive disparity between the EA's claims that sequoia reproduction is lacking versus the current on-the-ground high abundance of sequoia seedlings in the high-severity areas, and the fact that you are proposing this in Wilderness Areas, necessitates preparation of an Environmental Impact Statement.”

NPS Response

The EA was written and reviewed in consultation with resource and environmental compliance specialists (the full Interdisciplinary Team and their expertise is listed in Chapter 4 of the EA), and conclusions within the EA are supported by expert opinion and/or peer reviewed literature cited throughout the document—with some clarifications provided in the revised EA. The NPS also consulted the U.S. Fish and Wildlife Service (FWS), the California State Historic Preservation Officer (SHPO) (informally), and tribes regarding potential impacts of the proposed action.[4] The USFWS concurred on August 21, with the NPS’s determination that the now selected alternative *may affect but is unlikely to adversely affect* the fisher. In drawing these conclusions or concurring with NPS findings, these resource experts and consulting agencies and tribes did not identify any additional scientific studies or analyses beyond those provided to evaluate the environmental consequences of the action.

[4] In discussions with the California SHPO, the NPS determined that each planting would be an independent undertaking under the National Historic Preservation Act as each planting area is independent from the other for implementation. The NPS also determined that through complete avoidance of historic properties, including potential (i.e., unevaluated) historic properties, effects to cultural resources are predictable and anticipated to be a No Adverse Effect through avoidance. Historic properties identification and the full NHPA process will be initiated if and as the planting areas are refined, but this identification is not necessary to determine a FONSI.

One of the "circumstances that indicate an EIS is the appropriate NEPA pathway" is when "there is incomplete or unavailable information to the extent that a FONSI (resulting from an EA) cannot be supported" (NPS 2015, p 18). However, while agencies shall "ensure the professional integrity, including scientific integrity, of the discussions and analyses in environmental documents"; "make use of reliable existing data and resources"; "identify any methodologies used and…make explicit reference to the scientific and other sources relied upon for conclusions in the statement", "Agencies are not required to undertake new scientific and technical research to inform their analyses" (40 CFR § 1502.23), nor are they required to delay action to accommodate members of the public who wish to ground truth their findings, or to await the conclusion of new or independent research.

The NPS considered the request to complete a new hydrology study but determined that this study was not necessary to further inform the impact analysis as watershed studies for these areas had already been conducted for the Burned Area Emergency Response plans (as discussed on pages 11-12 of the revised EA). Furthermore, in reviewing these studies, the NPS concluded that while actions that disturb soil can further contribute to erosion, this project would not contribute to extensive soil disturbance beyond that already occurring in the system post fire, and restoring forest cover is expected to benefit soils by stabilizing them against further erosion in the long term.

Concerning one commenter's request for a genetic analysis of sequoia groves, the NPS worked with a population geneticist in forest biology to complete such an analysis—which discusses both the relatedness of southern sequoia groves, their genetic isolation, and apparent levels of gene flow—and provided the findings in Appendix E of the EA. See response to Concern Statement G3 for additional details.

The data and analysis associated with sequoia regeneration field surveys are not pertinent to informing the alternative selected for implementation or whether that alternative has significant impacts. See response to Concern Statement B1. Notably, in their comments related to needing field survey data to complete an EIS, this commenter does not question the findings of the environmental consequences within the EA or suggest the requested analyses are critical to understanding the environmental consequences. Rather, the requested data and analyses are fundamentally related to how the NPS is determining the purpose and need for action; specifically, regeneration/reproduction data within the potential planting areas and within other groves post-high severity fire and the threshold (based on reference density) of regeneration/reproduction that the NPS is relying on to determine if planting is likely needed. And while the commenter asserts that there are discrepancies within the sources upon which the NPS relies and questions the assumptions underpinning the NPS' purpose and need for action, the NPS relied on scientifically valid information to determine the purpose and need for action. Further, the NPS' interpretation and application of the information for making management decisions is appropriate. Refer to Section E for response to comments regarding the purpose and need of the action.

Furthermore, waiting for this regeneration analysis to make a decision on the EA is unlikely to generate a different result than the framework/decision-tree process outlined in the action alternatives themselves and, as explained in the EA, such a delay has the potential to impact project success. As explained in the EA on page 3, and further clarified in Appendix C of this FONSI, due to the conditions needed for successful seedling germination and subsequent survival, sequoia seedling germination primarily occurs in years one, two, and three post-fire as conditions for successful germination and survival are mostly gone by year three. As discussed within the EA and specifically addressed in response to public scoping comments (Appendix C of FONSI), all known peer-reviewed datasets and published studies of giant sequoia reproduction post-fire show a sharp decline from year 1 through year 5 in sequoia seedling densities with each year post-fire *on average* having fewer and fewer seedlings. Thus if sequoia seedling densities measured in year 2 do not show densities that are similar to those needed to establish a stable population (see Stephenson et al. 2023 and explanation in response to Concern Statement E2), there is no reason or previously produced data to indicate that this pattern will be reversed (e.g., all of sudden large numbers of sequoia seedlings germinate and survive in these project areas where the majority of seed trees are now dead and where conditions favoring seed germination and survival (friable mineral soil free of litter and duff) are rapidly diminishing).

Considering the above, the analysis within the EA and supporting documentation, and the project record as a whole, the NPS determined there is sufficient information to support a FONSI.

D. Comments Related to Compliance with the Wilderness Act

D1. Concern Statement: Actions Prohibited in Wilderness. Hundreds of commenters indicated that planting tree seedlings within wilderness is contrary to the Wilderness Act and/or indicated that associated actions to implement the selected alternative are not acceptable or are, in fact, prohibited, in wilderness. One group of commenters stated that the agency must provide a reasoned discussion of alternatives that avoids activities that are typically prohibited under the Wilderness Act.

Representative Quotes
*"The EA suggests that the negative effects to Wilderness character comply with the Wilderness Act because the project is necessary to restore giant sequoia groves, and alternatives that would cause less impact to wilderness character are not feasible. But see EA, Appx. D, p. 18 (Alternative D, which would cause much less effect on Wilderness character). But the question is not simply whether the Park Service met certain procedural requirements in analyzing the impacts of the Project under the Wilderness Act; rather, the Wilderness Act imposes substantive limits on wilderness management that require preservation of an area's "wilderness character."; It cannot be reduced to mere "paperwork hurdles"; See Wilderness Watch v. United States Fish Wildlife Serv., CV 23-77-M-DWM, at *25-26 (D. Mont. Aug. 2, 2023)."*

"The Park Service has essentially admitted that actions it has already taken and the proposed actions violate the Wilderness Act. In a blatant admission of Wilderness Act violations that have already occurred, the EA states that the removal of cones from these groves (both those from live remaining trees and those scattered on the ground) between 2021 and 2023 have likewise trammeled several of the project areas and other groves within the seed zones; EA, p. 57…Finally, the EA also admits that the presence of crews hiking to, camping within, and conducting post-fire monitoring or seed collection in all groves and those within the seed zone."

"the proposal violates the Wilderness Act: using mechanized equipment, motorized transport, installations, and it would significantly and adversely affect Wilderness character, pitting intense trammeling against the Park Service's desired conditions, while adversely impacting undeveloped qualities and opportunities for solitude."

"…I also am concerned about honoring the purposes of the Wilderness Act and Wilderness designation. It appears the NPS has overlooked these. It is less than humble of NPS to think it must "fix" Wilderness and that a plantation approach to such fixing is at all appropriate with in it. In fact, the Wilderness Act prohibits manipulating Wilderness. "Untrammeled" is how Wilderness is supposed to be…Planting trees and removing snags in Wilderness violates this fundamental tenet of Wilderness, that it remains unmanipulated by humans. Wilderness is meant to be shaped by

natural processes, including natural fires, and Wilderness Act author Howard Zahniser put it best when he implored managers to be "guardians not gardeners.""

"An agency must provide a reasoned discussion of alternatives that may avoid prohibited activity under the Wilderness Act. Alternative D would avoid many of those prohibited activities. Moreover, the Park Service must, at the very least, explain why anything more than Alternative D is necessary, given that it could lessen the adverse effects on Wilderness character better than Alternatives B or C. If Alternative D lessens those adverse effects while leading to similar results (978 acres versus 1,130 acres planted), then the adverse effects from Alternatives B or C are unnecessary."

NPS Response
Consistent with NPS Management Policies, the NPS completed a minimum requirement analysis to determine whether action was necessary in wilderness to correct a degradation resulting from high severity fire. This analysis included evaluating such factors as: 1) the situation that may prompt administrative action in wilderness, 2) whether or not action could be taken outside of wilderness to address the situation, 3) whether requirements of federal legislation require the NPS to act, and 4) whether action is necessary to preserve one or more qualities of wilderness character. The NPS also considered the cause and timing of the degradation, whether the NPS had authority to act, whether timely intervention was necessary to prevent further degradation, whether climate change or other ecological factors would reduce success, whether there was an identifiable goal, how intensive the action would be, and agency experience with the type of intervention being considered. Through this evaluation, the NPS determined that action was necessary in wilderness to comply with the requirements of other federal laws, including the National Park Service Organic Act, the parks' enabling legislation, and the Endangered Species Act, to comply with NPS policy and planning documents, and preserve the natural quality of wilderness character, specifically to preserve sequoias, to restore fisher habitat, and protect surrounding forests from future high severity fire. This analysis—which incorporates a supporting analysis in Appendix C of the EA, is included as Appendix D of the EA.

Section 4(c) of the Wilderness Act provides that "there shall be no temporary road, no use of motor vehicles, motorized equipment or motorboats, no landing of aircraft, no other form of mechanical transport, and no structure or installation" in wilderness "except as necessary to meet minimum requirements for the administration of the area for the purpose of this Act" (16 U.S.C. § 1133(c)). However, the Wilderness Act also states that: "Nothing in this Act shall modify the statutory authority under which units of the national park system are created. Further, the designation of any area of any park…as a wilderness area pursuant to this Act shall in no manner lower the standards evolved for the use and preservation of such park…in accordance with the [NPS Organic Act of 1916], the statutory authority under which the area was created, or any other Act of Congress which might pertain to or affect such area…" (16 U.S.C. § 1133(a)(3)). Put differently, the Wilderness Act makes clear that the Act does not modify or lower the standards for preservation of the parks under NPS Organic Act and the enabling legislation that established Sequoia and Kings Canyon National Parks.

The Organic Act directs the NPS to "conserve the scenery, natural and historic objects, and wildlife" in units of the National Park System "…in such manner and by such means as will leave them unimpaired for the enjoyment of future generations" (54 U.S.C. § 100101(a)). The enabling legislation for the parks demonstrates that they were created in order to conserve their natural resources, in particular sequoia trees. The NPS determined that the persistence of mature giant sequoia and preservation of fisher habitat connectivity is required to meet the parks' enabling legislation and other applicable laws, including the Endangered Species Act (16 U.S.C. § 1536(c)). NPS Management Policies (which are the agency's official interpretation of its Organic Act and provide specific and detailed guidance regarding the NPS's preservation obligations under the Organic Act) also require the NPS to maintain natural population processes and strive to protect a full range of native plant and animal genotypes. They also require that the NPS meet its obligations under the Organic Act and Endangered Species Act to protect threatened or endangered species and their habitat. Consistent with these policies, the NPS may manipulate landscapes and plant or animal populations if necessary to correct excessive disturbance caused by past human actions and when such actions would not cause unacceptable impacts. Park management plans and the Parks' Foundation Document also provide for the conservation of giant sequoia and fisher habitat. See Appendix B of the EA for relevant law, policy, and management direction as well as Section 1 of the MRA in Appendix D of the EA.

"Conservation" is furthermore identified as a public purpose of the Wilderness Act (16 U.S.C. § 1133(b)). Thus, actions taken to preserve, protect or conserve, natural resources, such as those analyzed in the EA, further this purpose of the Act.

Taking such actions as those prohibited under Section 4(c) complies with the Wilderness Act if they are found necessary to meet the minimum requirements for administering the wilderness area to accomplish this purpose. Having determined that action in wilderness was necessary, the NPS evaluated the minimum tools needed to accomplish this action. All told, the NPS evaluated 11 alternative means of accomplishing the conservation action determined necessary within wilderness. Several of these alternatives or alternative components were initially described in the MRA as additional alternatives but were not considered further because they were infeasible, unsafe, or would have too great an impact on wilderness character. The remaining alternatives were dismissed in the EA because they either did not safely resolve the conservation action determined necessary within wilderness, or because they would result in greater environmental impacts, including impacts to wilderness character. The impacts of each of the alternatives carried forward for detailed analysis in the EA—two of which were carried forward from the initial MRA—were analyzed for impacts to the four qualities of wilderness character for which status and trends are known. Through this analysis, the NPS determined that though the selected alternative will result in short-term negative impacts to untrammeled quality, undeveloped quality, and opportunities for solitude, it will preserve the natural quality in the long term and overall wilderness character to a greater degree than other alternatives. This analysis, and the NPS's decision are consistent with the Wilderness Act; the selected alternative will leave the parks' wilderness unimpaired for future generations in conformance with the Wilderness Act. See additional discussion on alternatives considered in response to Concern Statement F3.

D2. Concern Statement: Intervention is not justified. One group of commenters critiqued the NPS' analysis for deciding to "intervene" within wilderness (referencing the ecological interventions analysis included as Appendix C of the EA). This group of commenters specifically 1) disagreed with the NPS' approach toward protecting "natural" and "untrammeled" as two, separate, qualities of wilderness character, 2) criticized the NPS for not practicing restraint or demonstrating humility by "conflating desired conditions with natural conditions," 3) and stated that intervention is only appropriate "to the extent that it removes a direct, human-originated degradation to restore a naturally functioning ecosystem process"—concluding that the NPS improperly discounted the impacts of climate change as a factor in causing the degradation and suggesting the only appropriate response to the NPS' cited cause of degradation is reduced fire suppression.

Representative Quote

"The Wilderness Act, read as an internally consistent document as required by law, does not pit Wilderness characteristics against one another…what is natural for the area necessarily flows from what is untrammeled. Indeed, this is the common meaning of the term "natural." …It is the result of a process, not a static end point. Otherwise, the default position will always be to trammel Wilderness to comport with some land manager's notion of what is natural, even though various complicated factors—many of which we do not fully understand and cannot control—are always necessarily at play in shifting natural conditions, especially in the context of climate change. Here, the Park Service is conflating "desired conditions" with "natural conditions"; and creating a false conflict to justify trammeling actions in Wilderness. Ultimately, "whatever 'wilderness character' means, it cannot be something that depends upon the active manipulations of humans" Sean Kammer, 43 ENVTL. L. at 86 (2013). Restraint and humility are important values underpinning the Wilderness Act, and "[l]and managers should exercise this same humility in dealing with wilderness areas, lest they lead us down a path to where there are no longer any places that are truly 'wild,' no places beyond the control of human institutions and cultural imperatives." Id. The Park Service has utterly failed to restrain themselves and has lost its sense of humility in its belief that its desired conditions trump all other Wilderness values. The Park Service's own manual and policies unequivocally disfavor intervention. The ecological intervention analysis provided in an Appendix focuses too much on past fire suppression and fails to adequately factor in the effects of climate change that favor foreclosing ecological intervention. And even climate change…provides no adequate justification for discrete coercions within Wilderness. The eco-intervention manual makes clear that this is not grounds for doubling down on anthropogenic manipulation. The direct cause of post-wildfire conditions for sequoias at in each grove is a natural ecological dynamic, albeit one indirectly influenced by global atmospheric pollution and a century of fire suppression. Thus, the contemplated planting activity bears no direct connection to addressing the origin of the degradation, which the Park Service indicates will not change in the future because it will continue to suppress fires. If anything, the analysis shows that the Park Service should adjust its policies and allow more wildland fire to occur rather than suppress it, which is the change that the analysis suggests is necessary. Instead, intensive sequoia gardening would interrupt natural processes and supplant them with a manufactured end-state defined by normative human desires. To the extent that any ecological intervention is appropriate in Wilderness, it is only appropriate to the extent that it removes a direct, human-originated degradation to restore a naturally functioning ecosystem process. In this case that human-originated degradation is fire suppression and climate change itself, both of which must be addressed by the agency and society as a whole. It is never appropriate to use diffuse, indirect human effects to justify the proliferation of additional direct ones. To do so would be to abandon the very premise of Wilderness, that nature dictate its own processes."

NPS Response

As stewards of wilderness, the NPS must carefully consider each proposed action in wilderness through the lens of wilderness preservation, as directed by the Wilderness Act. To this end, the NPS completed a minimum requirements analysis to determine whether action was necessary in wilderness and the minimum tools needed as well as an analysis evaluating ecological intervention in wilderness consistent with the Wilderness Act agency guidance. The NPS' treatment of the untrammeled and natural qualities of wilderness in these analyses, and in the EA, is in alignment with interagency guidance (e.g., Landres et al. 2015) which treats "untrammeled" and "natural" as two separate qualities of wilderness character based on the language of the Act:

- Natural: "Ecological systems are substantially free from the *effects* of modern civilization… The Natural Quality is preserved when there are only indigenous species and natural ecological conditions and processes, and may be improved by controlling or removing non-indigenous species or by *restoring ecological conditions*" (Landres et al. 2015, emphasis added).
- Untrammeled: "Wilderness is essentially unhindered and free from the intentional actions of modern human control or manipulation…The Untrammeled Quality is preserved or sustained when actions to intentionally control or manipulate the components or processes of ecological systems inside wilderness (for example, suppressing fire, stocking lakes with fish, installing water catchments, or removing predators) are not taken. This quality is improved when suppression of wildfire or manipulation of habitat is stopped or significantly reduced" (Landres et al. 2015, 10-11).

The NPS administers wilderness to preserve the five qualities of wilderness character: untrammeled, natural, undeveloped, opportunities for solitude or primitive and unconfined recreation, and other features of value. Each quality is an equally important tangible component of wilderness character—no one quality predominates or trumps the others. Placing a higher value on the untrammeled quality of wilderness character than on the other qualities disregards the other qualities of wilderness character, the conservation purpose of wilderness, the purposes of the National Park System under the Organic Act, the purposes for which individual units of the National Park System are designated, and other values by which these lands are managed in accordance with other laws. It is also inconsistent with interagency guidance.

As demonstrated in the EA, including Appendices C and D, and in response to Concern Statement D1, the ecological, natural conditions in wilderness have been degraded as a result of the unprecedented extent of high severity fire during the 2020 Castle and 2021 KNP Complex Wildfires to such an extent that they are contrary to the conservation purpose of Wilderness, the purposes of NPS designation, and the protection and preservation of endangered species and their habitat. As also demonstrated in Appendix C of the EA, the NPS properly accounted for the impacts of climate change as a factor in causing this degradation, stating: "Factors driven by climate change, including extended periods of hotter, drier drought, and less snowfall (Diffenbaugh et al. 2015; Griffin and Anchukautus 2014) have contributed to fuels accumulations from the die-off of millions of trees in the Sierra Nevada. These factors likely contributed to certain sequoia groves and mixed conifer forests burning at high severity during the Castle and KNP wildfires." However, while all 27 groves in Sequoia and Kings Canyon National Parks that burned during these fires were subjected to these same climate-driven factors, not all experienced high-severity effects. In fact, groves with recent natural or prescribed fire, and thus less fuel accumulation, experienced largely beneficial effects; in comparison the six groves with a history of fire exclusion, and therefore higher fuel loads (e.g., surface fuel accumulations and standing ladder fuels), experienced severe effects (Shive et al. 2021). This key difference in pre-fire fuel conditions has led fire ecologists and sequoia experts to conclude that, were it not for high pre-fire fuel loading in the groves where severe fire effects were documented, more sequoias would have survived (A. Caprio personal communication January 2023) (see Chapter 1, EA references list, and References on pages 12-14 in Appendix C of EA).[5]

[5] To the commenter's suggestion that if fire suppression is the cause of degradation, the only action that would be the appropriate response would be to stop suppressing fires: The NPS acknowledges that some degree of suppression of wildfires will continue for a number of reasons that are not wholly driven by NPS policy. As described in, Appendix C, page 7 of the EA the "NPS is committed to a managed wildfire strategy when state air quality standards do not require fires to be suppressed, when such strategy would not threaten communities, when fire would be beneficial to the

These conditions are not only caused in part by past human-intervention, this degradation can be corrected with limited intervention, solely intended to restore ecological function of previously forested areas severely impacted by these high severity fires. In response to these wildfires, the NPS, supported by agency and research partners with the Burned Area Emergency Response program (BAER), used modeling data to identify resources at risk. As the BAER reports explain, modeling suggested that thousands of wilderness acres—inclusive of sequoia groves—were at risk of recovery failure (see NPS 2020 and NPS 2022, and pages 4-7 of EA) due to large contiguous areas of high severity fire causing previously unprecedented losses of sequoias across their Sierra Nevada range. Despite the scale of extensive forest loss, the NPS proposes to target only the most critical and sensitive resources—including those contributing to the natural quality of wilderness character (i.e., iconic and rare sequoia groves and endangered species) and continues to model and collect field data to further limit planting areas to locations where regeneration is insufficient—as determined by best available science—to restore a self-sustaining forest. The goal of the proposed action is limited—not to restore—but rather "direct the trajectory of severely burned areas toward forest recovery" (page 1 of the EA) and "once seedlings [are] established, the NPS anticipates that natural and dynamic post-fire recovery processes [will] continue…" (Alternative 2, on page 53 of the EA). In narrowing this goal, the NPS dismissed alternative components that included more extensive action such as watering seedlings and removing existing shrubs. Considering the above, the proposed action complies with applicable law and guidance, including RM 41: Wilderness Stewardship, which directs that the NPS act with "restraint" and only consider intervention when "necessary to preserve wilderness character as a whole" (RM 41: Evaluating Ecological Intervention in Wilderness, page 5).

In consideration of above, given that the commenters did not cite supporting evidence in their correspondence (nor were relevant research or data cited in an independent analysis submitted on behalf of these parties dated 1/05/2022), and given that the NPS has conducted all reviews in conformance with NEPA regulations and other relevant resource law and policy and supports assumptions and conclusions by citing both peer-reviewed literature and the data driven opinion of resource experts with decades of experience in these parks, the NPS concludes that no further action related to this concern is necessary to support a FONSI.

E. Comments that Question the Purpose and Need for Action

Hundreds of commenters questioned the purpose and need for action. While most of these comments were more general form letters, a few commenters raised specific questions about the scientific underpinnings of the purpose and need for action and how the NPS would ultimately determine—through field surveys and the application of a decision tree—that planting would occur (i.e., be necessary to achieve the purpose and need for action).

E1. Concern Statement: Assumptions. The NPS received several comments that stated the NPS' need for action is based on what a commenter refers to as false assumptions or inaccurate conclusions about anticipated sequoia regeneration and seedling mortality. Notably, many of

landscape, and when fire does not place resources at risk. More specifically, the Fire and Fuels Management Plan for Sequoia and Kings Canyon National Parks (2003) states that the NPS, through the plan and its implementation, "seeks to benefit park resources and society by restoring and maintaining the natural fire regime in a manner consistent with firefighter and public safety," and chief among the tools available to the NPS through that plan includes wildland fire use (i.e., non-suppression). As NPS policy is already to allow fires to burn to the extent feasible, and as the purpose of the EA is not to develop new policy, the NPS has determined that no further action is necessary to respond to this component of the concern.

these comments inaccurately represent the EA or point to outlier data that suggests natural regeneration is more likely than the NPS anticipates in the purpose and need for action.

Representative Quotes
"The EA's proposed plantation scheme is predicated on two assumptions from Stephenson et al. (2023): that about 80% of the 2022 seedlings would be dead by 2023, and that there would be little or no 2023 sequoia reproduction. However, both of these fundamental assumptions proved to be false, given the 2023 data."

"Importantly, Appendix 2 of Stephenson et al. (2023) directly contradicts this scientifically unsupported insinuation, showing that 83% of the sequoia groves studied had year two post-fire sequoia seedling densities below 14,112 per acre--most of them far, far below this level--and yet sequoias did not disappear."

"…among the Stephenson et al. (2023) fires with less than 14,122 sequoia seedlings per acre at year 2 post-fire—which comprise most of the fires analyzed by Stephenson et al. (2023)—the data from 5 years post-fire in these fire areas contradict the claim that sequoias will disappear in such areas, and many of these areas increased in sequoia seedling density by year 5 post-fire."

"In fact, Appendix 2 of Stephenson et al. (2023) contradicts the EA's assertion, showing that, even in these lower-severity fire areas (which create poor conditions for sequoia seedlings compared to higher-severity areas), and even in locations with only a few thousand sequoia seedlings per acre, a few hundred per acre, a few dozen per acre, or none per acre at year 2 post-fire, these areas remain populated with sequoias at year 5 post-fire (Stephenson et al. 2023 did not present any data beyond year 5 post-fire), and many of them have substantially higher sequoia seedling densities by 5 years post-fire than they did at 2 years post-fire, contrary to the EA's assumption that little or no new sequoia reproduction will occur after 1 or 2 years post-fire."

"The EA assumed that the density of year one post-fire sequoia seedlings would decline by about 80% by year two post-fire, yet your webinar shows that for Redwood Mountain Grove your year one post-fire sequoia seedling density was 4266/acre while your early summer 2023 density was 3863/acre--i.e., a mere 9% reduction compared to the 80% reduction that the EA predicted…the fact that your own figures indicate an extremely minor decline in sequoia seedling density--far less than the EA predicted--is a big deal. Why didn't you specifically note or divulge this?"

NPS Response
It is NPS policy to use the best available science to assist park managers in addressing management needs and objectives, as the NPS has done in this case. Notably, the NPS received a number of comments during public scoping that questioned the scientific underpinnings of the purpose and need for action—not too dissimilar from these comments received during public review of the EA. The NPS prepared a response to those comments prior to public review of the EA and requested that the USGS facilitate an independent peer-review of that response to ensure the NPS is appropriately interpreting the scientific literature related to:

1. Both the benefits of smaller patches of high severity fire and substantial concerns related to recovery within large areas of high severity fire;
2. Anticipated regeneration of sequoias every year post-fire—including and specifically within large patches of high-severity fire—and seedling survival rates within high severity areas;
3. Seed dispersal distances (that would indicate whether natural regeneration from surrounding live trees could contribute to future seedlings in the potential action areas); and

4. How the NPS determines whether there are "sufficient" seedlings present to ensure a stable forest population into the future, including the methods the NPS is using to survey seedlings (including seasonality and plot size).

USGS asked two independent scientists not associated with USGS or NPS or any other federal agency to review both the concerns as submitted by the commenter during scoping as well as the NPS response, and to provide their overall evaluation of the NPS response in terms of scientific adequacy. Both peer-reviewers concluded that the NPS response was adequate and met the standards of scientific peer review in its response to comments. One reviewer agreed with NPS position on the issues but made suggestions for how the NPS response to these issues could be even stronger and clearer, specifically around two issues: the strength of the sampling design used by NPS and the mechanisms by which sequoia ecology has potentially been disrupted by high severity fire. In summary, two independent forest scientists reviewed these issues as potential areas of concern and agreed with the NPS response to these issues. This response to public scoping comments has been added as Appendix C of this document, and additional details concerning similar comments from the public review period are outlined in the remainder of this Section E.

In response to these comments, it bears clarifying that the EA does not guarantee a certain level of natural regeneration or survivorship or lack thereof in forests impacted by large areas of high severity fire. Specifically, the EA does not state that sequoias will disappear from an area if there are not 14,112 seedlings per acre in year two post fire, or that 80% or more of the seedlings found in year one post fire will be dead in year two, or that there will be no new sequoia regeneration after year two post-fire. Rather, the NPS

1) Relies on credible, peer-reviewed scientific literature related to sequoia ecology to explain why there is cause for concern that these forests may not return to forests and the likelihood that they will instead convert to shrub-dominated communities; and,
2) Outlines a scientifically valid method to understand what level of regeneration most likely aligns with a stable, self-sustaining sequoia grove—taking into account the wide variation of sequoia seedling counts found in the reference data and field measurements—and determine at what level of regeneration the agency believes action is necessary.

To the first point above, the EA makes the following assumptions regarding giant sequoia reproduction that are supported by the literature as shown in the EA: (1) the *vast majority* of sequoia seedling regeneration occurs in year 1 and year 2 post-fire and (2) total sequoia seedling numbers *on average* decline over time, post fire. The NPS also discusses previous research documented in the published literature—and the high mortality rates of giant sequoia seedlings documented therein—in order to clarify why the NPS is concerned that reproduction may not be enough to re-establish self-sustaining giant sequoia forest despite the presence of naturally regenerating seedlings. See Appendix C, the revised EA, and the discussion in response to Concern Statement E3. To the second point above, see the response to Concern Statement E2.

Fundamentally, though some literature cited in the EA has gone through internal agency peer-review either through USGS or NPS and is currently in review for publication in scientific journals, the sum of scientific works cited in the EA demonstrates concern among contributing scientists that natural sequoia grove recovery is not assured in areas where regeneration is documented to be lower than reference densities cited in the EA.

Perhaps most notably, while a commenter identifies specific plots or datapoints that are contrary to the overarching findings within scientific literature and, if considered on their own, may indicate that planting is not needed, the NPS is focused—not on individual areas of success—but rather the likelihood that stable populations can be largely restored across large areas of sequoia groves versus the likelihood that they will instead largely convert to shrub-dominated communities into the future. This is why, as explained in response to Concern Statement E2, the NPS relies on a scientifically valid survey design and analysis of a spatially balanced randomly located set of plots across a large potential planting area and the probability of that data aligning with references densities that are estimated mean values and 95% credible intervals from a large multi-fire, multi-year dataset to determine whether or not to plant across the broad potential planting area. While there is uncertainty in future outcomes for forest recovery, the NPS proposed action is consistent with its conservation mission and other legal mandates. The EA provides comprehensive analysis of any potential impacts from taking the proposed action.

This plan to replant some areas under the selected alternative is consistent with the precautionary principle. Planting sequoia seedlings in burned areas poses little to no risks to ecosystem function whereas not planting has the potential to cause a long-term alteration in ecosystem function. If other plant species become established in the years immediately following fire, potential sequoia regeneration is not likely until the next fire and is only possible then if sufficient seed sources are present. When dealing with an iconic species like sequoia that has a very small natural range and requires considerable time to reach reproductive stature, promoting recovery, especially if those actions are reversible (e.g., through fire or mechanical treatment), is most closely aligned with restoration science and with the National Park Service Organic Act (1916),"…*to conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations*."

Now, to address various concerns raised by a commenter regarding the NPS' interpretation of the body of science referenced in the EA:

1. Is the NPS appropriately interpreting the scientific literature related to sequoia recovery post high-severity fire?
See Appendix C of this document and discussion in response to Concern Statement E3.

2. Is the NPS appropriately interpreting the scientific literature related to regeneration of sequoias every year post-fire—including and specifically within large patches of high-severity fire—and seedling survival rates within high severity areas?
See discussion above and responses to Concern Statements E2 and E7.

3. Is the NPS appropriately interpreting the scientific literature related to seed dispersal distances?
See Appendix C of this document. Although the Sequoia seed dispersal distance given in the EA cites Clark et al. 2021, the actual sequoia seed dispersal curve used in the paper (which was developed for that paper) is not presented in the paper and was instead obtained by A. Das of USGS from J. Clark, the primary author of the paper. This is the most up to date analysis of sequoia seed dispersal distance, but an earlier analysis, Clark et al. 1999, presents similar values for giant sequoia. The graph that NPS received from J. Clark, by way of A. Das, shows 95% of seed dispersal within 50 meters of the parent tree. This has been clarified in the revised EA.

4. Is the NPS appropriately interpreting the scientific literature to determine whether there are "enough", or "sufficient" seedlings present? Are the methods the NPS is using to survey seedlings (including seasonality and plot size) scientifically valid?
See discussion in response to Concern Statements E2 and E5.

E2. Concern Statement: Determining if Natural Regeneration is Sufficient. Several commenters indicated that the NPS had not clearly defined a threshold of natural regeneration under which the NPS would plant and/or indicated that there was no scientific basis for the NPS to use reference densities as a baseline under which regeneration was deemed inadequate. One commenter indicated that the studies relied upon by NPS do not support the EA's reference densities or draw conclusions about any thresholds under which intervention would be necessary, concluding that the NPS is misusing or mis-interpreting the studies.

Representative Quotes

"nowhere does the EA actually state the numerical sequoia seedling density threshold that you plan to use to make the decision to plant or not plant in any given area under your decision tree (Fig. 7 of the EA)."

"There is literally not a single scientific source that supports the fundamental premise of the EA--that if there are less than 14,112 sequoia seedlings per acre at year 2 post-fire, sequoias will disappear from that area. In fact, every single data source in existence that has investigated this question, including those cited by the EA and Stephenson et al. (2023), finds that by 25 years or so post-fire, there are vastly more young sequoia trees in high-severity fire areas than there are in low-severity surface fire areas. There are no exceptions to this in the scientific literature."

"Stephenson et al. (2023) does not make a conclusion that sequoias will disappear in a particular area if year two post-fire sequoia seedling density is less than 14,112 per acre. Stephenson et al. (2023) merely reports that, at two years after lower-severity prescribed fires, there is typically an average of 14,112 sequoia seedlings per acre. In fact, Appendix 2 of Stephenson et al. (2023) contradicts the EA's assertion, showing that, even in these lower-severity fire areas (which create poor conditions for sequoia seedlings compared to higher-severity areas), and even in locations with only a few thousand sequoia seedlings per acre, a few hundred per acre, a few dozen per acre, or none per acre at year 2 post-fire, these areas remain populated with sequoias at year 5 post-fire (Stephenson et al. 2023 did not present any data beyond year 5 post-fire), and many of them have substantially higher sequoia seedling densities by 5 years post-fire than they did at 2 years post-fire, contrary to the EA's assumption that little or no new sequoia reproduction will occur after 1 or 2 years post-fire…Perhaps more importantly, to the extent that this speculative comment is being used by the EA to assume that sequoias will disappear in areas with less than 14,112 sequoia seedlings per acre in year 2 post-fire, In fact, in Appendix 2 of Stephenson et al. (2023), for plots where some sequoia regeneration was recorded at some point after the prescribed fires (p. 5) says currently exists in the Board Camp Grove, by year 5 post-fire 3 of the plots fitting the above description had the same or lower density of sequoia reproduction, while 9 had higher sequoia seedling density by year 5 post-fire. This stands in stark contradiction to the assumptions in the EA that: (a) the great majority of the year 2 post-fire seedlings will be dead by year 5 post-fire; (b) little or no new sequoia reproduction will occur after the first year or two post-fire, and essentially none will occur after year 2 post-fire; and (c) in areas with dozens or hundreds of sequoia seedlings per acre at year 2 post-fire, sequoias will disappear in such locations."

"The York et al. (2013 study does not support the EA's assertion that sequoia reproduction will disappear if year two post-fire sequoia seedling density is less than 14,112 per acre." Nowhere does York et al. (2013) make a conclusion that sequoias will disappear in areas with less than 14,112 sequoia seedlings per acre at 2 years post-fire. Nor does the "stable population" graph in York et al. (2013), which the EA relies upon on pp. 3-4, support the EA's tree planting threshold. In fact, Table 1 of Subappendix 1 of York et al. (2013) states that the "stable population" graphs shown in Figure 1b of York et al. (2013) are based on two plots totaling 14.7 hectares. Figure 1b of York et al. (2013) shows approximately 6,000 sequoia seedlings on these 14.7 hectares in their stable

population distribution figure, which equates to approximately 400 sequoia seedlings per hectare, or about 160 sequoia seedlings per acre, not 14,112 per acre."

NPS Response

The EA, clarified via the revised EA, explains that based on supporting studies of expected seedling density, evaluation of site-specific climate, recommendations from published literature (North et al. 2019; York et al. 2013b; York et al. 2020), and technical reports (Stewart 2020), the NPS is proposing to plant 100 to 400 total seedlings per acre in areas where assessments under the decision tree outlined in the EA indicate that the Bayesian estimated mean density of seedlings per acre at two years post fire has less than a 90% probability of achieving the estimated mean of 16,011 seedlings per acre reference density (14,112 sample mean density[6]) calculated from Stephenson et al. 2023 (in preparation) and therefore may not recover a stable sequoia population without intervention. Because several groves were not sampled until three years post-fire (Upper Dillonwood and Homers Nose) and because the dataset used to calculate reference densities only has values at one, two, and five years post-fire, the research team, which includes NPS and USGS staff, are still developing an approach on what appropriate reference density should be used for a conservation-oriented decision likelihood threshold. Ongoing development of the threshold reference density for these groves does not affect the impact analysis presented in the EA or the determination that a FONSI can be supported.

While the NPS received a number of comments criticizing how the NPS arrived at this threshold and the sources that the NPS relies upon to determine this threshold, all of these comments either inaccurately represent the NPS' interpretation of the sources or draw conclusions or interpretations of the data that are not scientifically supported. In order to clarify any misunderstandings on this topic, the NPS' interpretation of and rationale for the use of York et al. 2013a and Stephenson et al. 2023 (in preparation)—which upon review the NPS affirms is still accurate and appropriate—is outlined below.

Details Concerning the Application and Interpretation of York et al. 2013: Understanding the Stable Age Structure of Giant Sequoia Groves

As identified in the EA, the "goal of the proposed action is to direct the trajectory of severely burned areas toward forest recovery" (page 1), but to do so, the NPS needs to ensure that post-fire seedling densities are sufficient to create a *stable age structure* in the population. Given that giant sequoias have high mortality in seedling size classes, are very long-lived, and rely on larger, older trees to survive fires and other disturbances and produce the vast majority of cones,[7] the NPS is concerned that if seedling densities within the potential action areas do not reflect (in number and probability) estimated mean values of seedling densities in areas that are indicative of a stable age structure, there *may* not be enough seedlings to have enough sequoias survive to 40, 80, 100, 400, 1,000 years old to create a stable age structure (e.g., a stable population of sequoias), reflecting that present in these areas prior to high severity fire. The project goal is to direct the severely burned areas toward forest recovery, and field measurements of seedling densities are being used as an indicator that the sequoia population is or is not back on a trajectory to re-establish mature sequoia trees in the project areas. In other words, the presence of seedlings post-fire is not, alone, indicative of a stable population of sequoias into the future as there may be thousands of seedlings per acre, two years post fire, and still hundreds of small trees per acre, ten years post fire, but

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[6] The per acre sample mean at two years post-fire is the number most commonly cited in the EA (14,112 sequoia seedlings per acre).

[7] Harvey et al. (1980) estimate that sequoia trees on average 400 years and older are the trees that bear the most cones and thus are critical for sequoia reproduction (Harvey et al. 1980 p.47).

eventually, over time, these numbers of sequoia trees may not be enough to create a sequoia forest that is capable of maintaining itself over time (i.e., a stable age structure).

The NPS evaluates this possible decline over time through reference to the only available population demographic model for giant sequoia, produced by York et al. (2013a). Specifically, the NPS used this population demographic model and its comparison to prescribed fire data for two purposes: 1) to indicate what the stable age structure for giant sequoia might look like, and 2) to establish that age structures in sequoia groves with prescribed fire are similar to the population structure of the modeled stable age structure (notably, Stephenson et al. (2023, in preparation) provides reference post-fire densities for which to compare field surveys, which is described further below). The York et al. (2013a) model works with 10-year increments of survival and displays densities over 100-year time steps and compares this model of stable age structure to two grove areas without fire in the last century and two areas with recent prescribed fire to evaluate departure from this stable age structure with and without fire. This analysis indicated that areas with prescribed fire were similar to the stable age structure model and thus were more likely to result in replacement of large reproductive sequoia trees over time (over 400 to 1000 years). The two quotes from York et al. (2013a) below indicate what the data and analysis were and how they were intended to be used, which is consistent with how the NPS is using them.

> Here we present the results of the first demographic model for giant sequoia. A predicted age distribution was derived from empirical data to describe what a long-term stationary population of giant sequoia looks like. This is a relevant reference for management decisions influencing giant sequoia, considering the emphasis of recent studies and treatments on encouraging giant sequoia regeneration as a means for addressing regeneration failures associated with fire suppression over the past century. Additionally, it provides a reference, not from reconstructed past conditions, but from modern era data and calculations that rely on basic demographic information about giant sequoia. While there remains uncertainty in precisely how dense new giant sequoia cohorts need to be in order to sustain local populations, the shape of the expected distribution can be used as an important reference for evaluating whether treatment options (i.e., burning frequently, infrequently, or not at all) move the age structure closer or farther from an expected stationary distribution.

This quote points out three important points relevant to the commenter’s stated concern:

1. The data and analysis are intended to be used in the way NPS is using them: as information and indicators for whether a management action or lack of one will move the age structure closer or farther from a sustainable population (stationary distribution).
2. This analysis is based on measured and modeled demographic data.
3. There is uncertainty in the exact densities required, which the NPS acknowledges.

York et al. (2013a) furthermore states:

> The importance of the comparison between the predicted distribution and the actual distribution highlighted here occurs when evaluating the relative departure from expected in the youngest age class (< 100 years old). The burned area results in the establishment of younger cohorts that move the overall structure closer to what is expected (Figure 1, bottom). While the unburned areas do have trees in the youngest age class, the relative decline in the number of young trees moves the distribution in the opposite direction from a sustainable distribution.

Here, York et al. (2013a) does not give a specific seedling density needed to maintain a stable age structure, and the NPS does not rely on seedling density data in York et al. 2013a to determine the seedling reference densities as comments suggest. Nor does York et al. (2013a) say that without fire or a specific value of young sequoias that all sequoias will disappear; the NPS does not say this in the EA either. Rather, York et al. (2013a) is stating that the density of young sequoias found after fire was similar to that found in a modeled sustainable age distribution.

The NPS thereby concludes that the agency’s use of York et al. 2013a is appropriate to understand what a stable age structure might be for a tree that lives for 3,000 years and typically has high mortality for seedling size classes. The NPS additionally reached out to both York and Stephenson (the two main authors of York et al. 2013a) and explained how the data and analysis are being used by NPS in the EA. Both York and Stephenson concurred, informally, that this use was appropriate.

It is unclear how the commenter concluded, based on their analysis of York et al.’s (2013a) data a year two reference density of 160 sequoia seedlings per acre, nor does the commenter provide detail on how this conclusion was reached. The York et al. 2013a data, as presented, do not support this level of time resolution in terms of seedling density—which is notably a key reason the NPS does not rely on York et al. 2013a to determine seedling reference densities. York et al. (2013a) only modeled survivorship and densities at 10-year increments and only showed results in Figure 1 in 100-year increments. Similarly, the two fires that were used in the York et al. 2013a analysis were measured 25 years post-fire (Mariposa Grove) and 8 years post-fire (Giant Forest). The densities measured in these areas are therefore not scientifically relevant to calculate a year 2 reference density.

Details Concerning the Application and Interpretation of Stephenson et al. 2023: Identifying Estimated Mean Seedling Density Thresholds

Because York et al. 2013a does not provide sufficient annual data resolution or samples to calculate reference densities immediately post-fire that could be used to indicate whether a stable age structure is likely, Stephenson et al. (2023, in preparation) take prescribed fire plot data, QA/QC this data, and aggregate it across fires by year since burn to calculate the sample mean and Bayesian estimated mean seedling and 95% credible interval densities at different time steps. Stephenson et al. (2023, in preparation) also compare data from within the project area, as provided in Soderberg et al. (2023, in review), to the prescribed fire reference densities using the probability that the Bayesian estimated population mean in specific project areas is equal to or greater than the reference densities from prescribed fires (based on the conclusion of York et al. 2013a that sequoia groves that had prescribed fire had age structure that was similar to a stable age distribution).

In the EA, the NPS proposes to use the reference densities in Stephenson et al. (2023, in preparation) to compare to the Bayesian estimated mean seedling densities as was done for two example groves in Stephenson et al. (2023, in preparation) in order to estimate the likelihood that measured reproduction in field surveys is indicative of densities sufficient to establish a stable population in each of the potential action areas. The NPS agrees however that the EA did not clearly articulate this point—in part due to the complexity of such analysis—and therefore determined that clarification via the revised EA would be helpful. The NPS finds that this use is well supported by the analysis in Stephenson et al. (2023, in preparation) and is consistent with how the data and analysis were intended to be used. In a short conversation with Stephenson regarding this issue, he communicated to an NPS staff member that he did not consider the use of the analysis by NPS (as described to him) to be incorrect or inconsistent with his work (N. Stephenson personal communications August 2023). (Notably, there are no discrepancies between the EA's stated planting thresholds regarding sequoia seedling densities and the reference values provided in Stephenson et al. (2023, in preparation). The values in Stephenson have been converted from seedlings/hectare into seedlings per acre to be consistent with the use of English units in the rest of the EA).

The same commenter who indicated the NPS was improperly using Stephenson et al. (2023, in preparation) also states that the Stephenson et al. (2023, in preparation) data do not support the reference densities presented and suggests the paper is contradictory. To explain, the commenter provides examples of fires in Stephenson et al. (2023, in preparation) data where year two post fire seedling densities were below the 14,112 per acre outlined in Stephenson et al. (2023, in preparation) and calls out examples of plot data where seedling densities increased from year 2 to year 5. First, the data used, and the analyses presented in Stephenson et al. (2023, in preparation) have been peer-reviewed following USGS guidelines prior to making them public on the pre-print server; the USGS peer-review process found both the data valid, and the analyses presented sound. In contrast, the selection of a subset of data from individual fires to calculate reference densities is inappropriate as Stephenson et al. (2023, in preparation) chose to aggregate by time, not by fire. This is because the number of plots per fire is not high enough to generate an accurate mean per fire (most fires in the record typically have only one or two plots and the plots are relatively small so there is not enough replicates or sufficient area to accurately sample a single fire). The reference densities outlined in the comment are therefore incorrect and are not supported by the data.

The comment's reliance on a small subset of plots where seedling numbers increase from year 2 to year 5 is also not supported by the data as described above. The plots highlighted in the comment show small increases in seedling numbers that are well within measurement error. Individual plots in the Stephenson et al. (2023, in preparation) dataset vary in their exact number of seedlings year to year due to several factors that introduce measurement error including small variations in the counting by different observers since individual seedlings are not marked and additional errors can arise because the size of the area in which seedlings were counted can vary from year to year. Thus, noting a small increase or decrease in seedling number from year to year should not be used to draw conclusions of significant increase or decrease and is not supported by the data. Specifically, the reference values from Stephenson et al. (2023, in preparation) do not assume any survival rates but rather estimate mean seedling densities and 95% credible intervals at year 1, year 2, and year 5 post-fire based on a large dataset of measured post-fire sequoia seedling densities at 42 sites burned in 26 different fires over a 48-year period. The data are annual counts and do not track fates of individual seedlings; yearly counts include the germination. It is worth noting here that in the Stephenson et al. (2023, in preparation) dataset, individual seedlings were not marked and tracked, which introduces additional measurement errors in counting and thereby gives a net change, not survivorship of individuals. It is therefore not accurate to make assumptions regarding survivorship of seedlings at various timeframes from this data. The only way to accurately measure survivorship is to mark individual seedlings and track them from the beginning of year one germination season through to the end of year two germination season; any observational data that record observed dead seedlings or total seedling counts are not reliable estimates of survivorship since they do not indicate when seedlings germinated, and dead seedlings may be lost from the record due to desiccation or erosion (via air or water). The only study that NPS knows of that tracked sequoia individuals (Harvey and Shellhammer 1991) found continuous decline in seedlings over time since fire, even with new germinants occurring in year 2.

Ultimately, the Stephenson et al. (2023, in preparation) analysis was done using a specific set of methods and analysis tools in order to not exceed the accuracy and extent of the data used: the plots in Stephenson et al. (2023, in preparation) are few per fire, do not mark and track individual seedlings, include change in plot size from sample period to sample period in some instances due to the protocol used, and like any data, include some degree of measurement error. The aggregation and calculation of Bayesian estimated means, and probabilities were judged by the authors to be the most robust and accurate way to analyze this data for the purpose of calculating sample and population mean densities one-, two-, and five-years post-fire, and the data, analyses, and conclusions in Stephenson et al. (2023, in preparation) underwent USGS peer-review and were found to meet scientific standards. In comparison, the comment draws trends and conclusions from selections of subsets of the data that are not supported scientifically by the data nor appropriate to the area and sample size of these smaller subsets, and no justification is provided for the selection of these subsets of the data to support the treatment of the data in this manner. The analysis presented by Stephenson et al. (2023, in preparation) has been judged correct by USGS peer-review and that analysis fits the limits of the data.

Conclusion

The NPS interprets Stephenson et al. 2023, in preparation and York et al. 2013a to conclude that if seedling densities within the potential action areas do not reflect (in number and probability) Bayesian estimated mean values of seedling densities in reference dataset from areas that are indicative of a stable age structure (as indicated by Stephenson et al. (2023, in preparation)), there **may** not be enough seedlings to have enough sequoia trees survive to 40, 80, 100, 400, 1000 years old to create a stable population of sequoias, such as were present in these areas prior to high severity fire. (More precisely, a stable age structure capable of replacing itself over the long-time scales that sequoia forests operate will be less likely to occur if the reference density is not met.) The revised EA has clarified this further.

For this reason, the mere presence of sequoia seedlings post-fire does not, on its own, indicate that the grove will fully recover to a sustainable population, particularly as there are few to no reproductive trees within the potential planting areas to contribute future seedlings while waiting for a large number of current seedlings to reach a sufficient age/size to contribute large numbers of cones to ensure the population has sufficient reproductive capacity to replace itself—a scenario that is not likely for several hundred years. Therefore, as identified in the EA, the "goal of the proposed action is to direct the trajectory of severely burned areas toward forest recovery" any measured sequoia seedling densities post-fire needs to be compared to reference values associated with a stable age structure in giant sequoias over the long time periods needed to establish mature giant sequoias. This is why the NPS is using the demographic model in York et al. 2013a and reference densities from Stephenson et al. (2023, in preparation) as indicators of population trajectory similar to one capable of producing a stable age structure; the 1-year, 2-year, 5-year time step regeneration numbers are being used as an indicator of whether or not establishment of a stable age population without intervention is likely.

On a final note, the NPS requested that the commenter provide supporting data, studies, and rationale (such as a stage- or age-based model or life-table analysis) if they had recommendations pertaining to a threshold on which the NPS should rely. Although they provided the comments above, the commenter did not recommend an alternative approach other than to ground truth the NPS' field data with other researchers and to gather more regeneration data to understand if seedlings are present, if not increasing, by/in year 5 post-fire. This suggested approach (i.e., to continue to take data in year 4 and year 5 post-fire before making a decision), as explained in the EA, is unlikely to generate a different decision than the process described in the EA's decision-tree and as additionally explained in the EA, has significant potential impacts to project success. As explained in the EA on page 3 in the background section and further described in Appendix C of this FONSI, due to the conditions needed for successful seedling germination and subsequent survival, sequoia seedling germination occurs primarily in years one, two, and possibly three, post-fire, as conditions for successful germination and survival are mostly gone by year three. As further described in additional detail provided in Appendix C, all known peer-reviewed datasets and published studies of giant sequoia reproduction post-fire show a sharp decline from year 1 through year 5 in sequoia seedling densities with each year post-fire on average having fewer and fewer seedlings. Thus if sequoia seedling densities measured in year 2 do not show densities that are similar to those needed to establish a stable population (see Stephenson et al. 2023, in preparation, and explanation above), there is no reason or previously produced data to indicate that this pattern will be reversed and, all of a sudden, large numbers of sequoia seedlings will germinate and survive in these project areas where the majority of seed trees are now dead, and where conditions favoring seed germination and survival are mainly gone due to the recovery of an unsuitable organic seedbed and competing vegetation within the project area as time since fire increases.

E3. Concern Statement: Applicability of Stephenson et al. 2023 in Determining Need.
One commenter critiqued the use of Stephenson et al. (2023, in preparation) to determine the thresholds for regeneration specifically because this paper incorporates data from low and moderate severity fire, where regeneration tends to be lower than in patches of high severity fire. This commenter specifically states that the reference data is not appropriate because, they maintain, high severity fire typically result in higher survivorship and higher seedling densities.

Representative Quotes
"The EA's use of post-fire sequoia seedling survival data from low-severity surface fires to make assumptions about seeding survival in high severity areas is scientifically inaccurate and unsupportable. Stephenson et al. (2023) uses data regarding sequoia seedling survival from about two dozen lower-severity surface fires (prescribed fires). However, the studies that the EA itself references (York et al. 2013, Meyer and Safford 2011, and Harvey and Shellhammer 1991) show that sequoia seedling survival is vastly higher in high-severity fire areas than in low-severity surface fire areas. Meyer and Safford (2011), for example, report (p. 12) that sequoia reproduction survival is 7 to 11 times higher in severely burned sites than in low-severity surface fire areas. …York et al. (2013) (p. 39) cautioned against assuming that larger high-severity fire patches will impede giant sequoia reproduction or reduce overall sequoia populations: Its life history suggests that it may actually increase following extensive high-severity fires, which have been increasing in the recent past. Figure 3B of York et al. (2013) shows that, by 25 years post-fire, the highest density of young sequoia trees occurs in high-severity fire areas, and York et al. (2013) note that these young sequoias regenerating from high-severity fire areas are the trees most likely to become mature sequoias"

"By 22 years post-fire, sequoia seedling survival is more than 50 times higher in higher-severity fire areas than in lower-severity surface fire areas, according to Harvey and Shellhammer (1991). By about 25 years post-fire, high-severity fire areas produce over 100 times greater density of young sequoia trees by about 25 years post-fire, according to Meyer and Safford (2011) and York et al. (2013). None of these key findings are mentioned in the EA or in Stephenson et al. (2023)."

"As acknowledged by these studies, high-severity fire gives sequoias the three things they need to effectively reproduce: i) sufficient heat to allow a sequoia's serotinous cones to release their seeds; ii) an intensity that consumes the thick duff and litter on the forest floor, turning it into a nutrient-rich bed of mineral ash that spurs seedling growth, and allowing seedlings to sink their roots into soil; and iii) killing of most or all canopy trees to give young seedlings the sunlight they need to thrive."

NPS Response
As discussed in response to Comment 2 in Appendix C, previous studies have indicated that conditions in small patches of high severity fire tend to be ideal for regeneration as they are associated with higher numbers of seedlings, higher survivorship, and faster growth (Hartesveldt and Harvey 1980, Harvey and Shellhammer 1991, Meyer and Safford 2011. etc.). Given these advantages, one might assume that areas that burned at high severity fire following the 2020 Castle and 2021 KNP Complex Wildfires would have: 1) higher numbers of seedings, 2) higher seedling survivorship, and 3) faster seedling growth than the plots surveyed within Stephenson et al. 2023 (in preparation), which includes data from low and moderate severity fires. However, the large patch sizes of high severity fire within the potential action area are unprecedented and, unlike those found in previous studies, in such a way and to such an extent as to question, with reasonable basis, the applicability of these previous studies to the situation the NPS is facing.

For example, although regeneration in high severity areas has been found to be higher than in areas impacted by low and moderate severity fire, the data collected thus far in these large, contiguous areas of high severity fire show, in fact, lower regeneration than the reference densities of Stephenson et al. 2023 (in preparation). Data collected to date by NPS in the project areas shows that estimated mean seedling numbers in year 1 and 2 are lower than the estimated mean values found for similar lengths of time postfire in prescribed fires (e.g., the reference densities in Stephenson et al. 2023, in preparation). Thus, there is not higher germination and survivorship through years 1 and 2 in the project area than in the prescribed fire dataset used to generate reference densities.

This factor is particularly concerning given that one of the most important differences between the project areas and previous studies of sequoia regeneration after fire is the death of the vast majority of sequoias throughout the project area. This mortality (estimated mean sequoia mortality in Redwood Mountain project area was 90% Soderberg et al. 2023, in review) of large sequoias means that these areas will not have continued seed input each year because the seed trees are dead.

It is also currently unknown whether the survivorship going forward could be higher than that found in the prescribed fire dataset such that fewer seedlings would be needed to establish a stable population of sequoias. The data required to make such an assessment from tagging, tracking, and calculating annual survivorship for sequoia seedlings in large high severity fire areas, does not exist. However, considerations are outlined in Stephenson et al. 2023 and the EA to suggest that survivorship over the next two decades could be much lower, not higher, than the specific data from high severity patches in previous studies that the commenter calls out. Additionally, and as detailed in Stephenson et al. 2023, these same considerations could mean that survivorship in the project area may also be lower than the prescribed fire data used to calculate the reference densities given the following factors.

1. First the project areas are large and treeless and previous studies have shown that such areas retain less snow and have faster snow melt in comparison to smaller gaps (Stevens 2017, Gleason et al. 2019, Smoot and Gleason 2021, Hatchett et al. 2023) resulting in more arid conditions which could reduce survivorship of sequoia seedlings.
2. Second, canopy torching has resulted in a reduction in leaf litter because the tree canopies, including needles, were consumed directly by fire and thus will not fall to the ground in subsequent years. Leaf litter has been shown to reduce soil temperatures and increase sequoia seedling survivorship (Stark 1968). Thus, limited leaf litter could again reduce

sequoia seedling survivorship over what has been measured previously after prescribed fires—including in small high severity patches in the past.

3. Third, temperatures within the study area are rising and are expected to continue to rise (Stephenson et al. 2023, in preparation, Edwards and Redmond 2011, Das and Stephenson 2013) and warmer temperatures could decrease survivorship going forward.
4. Fourth, there is evidence that areas that have burned once at high severity are much more likely to reburn at high severity (Coop et al. 2020). If a high severity fire occurs in these areas before sequoias are old enough to withstand fire, the vast majority, if not all, of the existing regeneration could be lost. One of the goals of the replanting is to accelerate canopy formation and increase tree seedling density in order to more quickly shade out shrubs and reduce the likelihood of future high severity fires.
5. Finally, the analysis included in Soderberg et al. 2023 also found that sequoia seedling densities declined with increasing fire severity as measured by Relativized Normalized Burn Ratio (RdNBR). Indicating that higher severity fire, at the extreme ends of high severity, is not better for sequoia seed germination and seedling survivorship (data analyzed were collected after the majority of year 1 mortality had likely already occurred and thus reflect the outcome of germination and initial mortality during the first summer).

Given that the current condition (i.e., large areas where all living sequoias have died due to high severity fire) has never occurred before, the NPS must rely on the best available science to determine where regeneration failure may occur. To this end, the dataset used in Stephenson et al. 2023 (in preparation) is not only the only existing data that can help us understand what seedling densities might be required to reestablish self-replacing giant sequoia forest in these areas, but also that while there is uncertainty regarding the survivorship of sequoias in these areas, the use of this data is appropriate within the decision-tree presented in the EA. The dataset used in Stephenson et al. 2023 (in preparation) includes low, moderate, and high severity fire data—reflective of pre-European fire regimes (which includes patches of high severity fire). Several studies have concluded that prescribed fires within Sequoia and Kings Canyon National Parks have generated similar effects to those of pre-European fire regimes which included patches of high severity fire effects (Stephenson 1996, Mutch 1994, Demetry 1995). Further, Demetry (1994) studied gaps of various sizes created by prescribed fires in Giant Forest, demonstrating that prescribed fires are capable of, and frequently do produce gaps of different sizes including those large enough to have giant sequoia regeneration and survival as documented in Demetry 1995. Finally, the demographic graph shown in York et al. 2013a shows the large number of young sequoias that occur in stands that experience prescribed burning in comparison to unburned stands (Figure 1 bottom), thus supporting the idea that prescribed fires burn at sufficient intensity to create gaps that produce cohorts of young sequoias. While the prescribed fire dataset does not capture the exact same conditions as those found in the large high severity fire areas proposed for planting, as is discussed in Stephenson et al. 2023 (in preparation), it is the best dataset the NPS has as a reference since this type of large high severity fire has never previously been documented or known to occur in giant sequoia forest despite extensive paleo history and tree ring history studies of giant sequoia groves.

On a final note, a number of authors who have previously documented the benefits of patches of high severity fire (including Meyer and Stephenson) have since conducted studies on the impacts of the recent, large, high severity fires on giant sequoias and have found major impacts to sequoia survivorship and reproduction. As but one example: Dr. Rob York, assistant professor of cooperative extension in UC Berkeley’s forestry program, who has studied and documented the benefits of small patches of high severity fire, stated in reference to this proposed project, “These fires are behaving in a way that giant sequoias can’t really adapt to. When fires are high severity, they kill the seed supply, and they kill the trees that provide the seed supply” (San Francisco

Chronicle August 14, 2023). As stated in this article, Dr. York does not think the high severity fire analyzed under the EA was good for giant sequoias. Nor does he indicate these conditions are likely to result in abundant and long-surviving natural reproduction. Rather, previous papers that have documented the benefits of small patches of high severity fire are not representative of the current scientific understanding of impacts of these recent high severity fires on the species.

E4. Concern Statement: Need for Planting in Mixed Conifer Forests. One commenter indicated that the planting in the mixed conifer habitat outside of Redwood Mountain Grove was not scientifically supported, and another commenter indicated that the threshold developed by the NPS to determine need for planting was baseless. While yet another suggested that mixed conifer regeneration in sequoia groves may be sufficient.

Representative Quotes
"…planting trees will do little to restore fisher habitat in the short-term because Pacific fisher require old-growth forest that will take hundreds of years restore, most of which will occur naturally without ecological intervention."

"With regard to the several hundred acres of mixed-conifer forests outside of the sequoia groves where the Park is also proposing tree planting, the EA's 14,112 seedlings per acre threshold is also unsupported, given that the studies cited by the EA pertain to sequoias, not mixed-conifer tree species, and given that the government's own scientists and university scientists recommend natural post-fire conifer regeneration at the level of dozens per acre to low hundreds of conifer seedlings per acre (Owen et al. 2017, North et al. 2019), not 14,112 per acre, and mixed-conifer reproduction often does not even begin until 3 or more years post-fire in high-severity fire areas (Hanson and Chi 2021)."

"In Appendix C, p. 8/14, referring to planted seedlings, is said that there is no evidence that seedlings will not survive and that trees will not reestablish. Well, there are thousands of naturally germinated GS seedlings up there right now. And there are likely (but numbers are not reported in the EA) seedlings of the other mixed conifer forest tree seedlings. So, ARE WE STILL convinced that the No Action Alternative or an Alternative 4, "wait and see alternative" won't be successful with Nature acting on its own. That should be in an EIS."

NPS Response
With regards to the need for planting within the 485-acre proposed critical habitat for fisher (i.e., mixed conifer forest; not sequoia grove), the EA discusses the mounting evidence of and concern among forest ecologists and managers regarding type conversion of forests to shrublands under repeated high severity fires and these fires interacting with drought (see pages 1, 19, 36, Appendix C of the EA, as well as other locations in the EA where type conversion is discussed).

To better understand natural generation post fire, the NPS surveyed mixed conifer regeneration in 2022 and 2023 in areas of high severity fire effects predicted to have low conifer regeneration by the POSTSCRPT model. Plot locations and a summary showing exceptionally low conifer regeneration in plots sampled in 2022 (2023 data is not yet available for release) can be found in Meyer et al. 2022 which is referenced in the EA and available in NPS records. The 2022 survey data from Redwood Mountain Grove (where sequoia and non-sequoia seedlings were both counted) found white fir averaged 27.1 seedlings/acre (67 seedlings/hectare (ha)), sugar pine 0.81 seedlings/acre (2 seedlings/ha), incense cedar 21.8 seedlings/acre (54 seedlings/ha), and ponderosa pine 0.41 seedlings/acre (1 seedling/ha). From high severity mixed conifer plots distributed across the KNP fire footprint in mixed conifer areas that POSTSCRPT modeling indicated were likely to experience regeneration failure—which included a large number of plots within the fisher habitat corridor south of Redwood Mountain Grove—Meyer et al. 2022 found an average of 7.3 white fir seedlings/acre (18 seedlings/ha), sugar pine 0.8 seedlings/acre (2 seedlings/ha), incense cedar 4.9 seedlings/acre (12 seedlings/ha), and ponderosa pine 4.9 seedlings/acre (12 seedlings/ha). Forty percent of mixed conifer plots contained zero conifer seedlings and 60% contained a very low density of 20 or fewer seedlings per hectare. These data indicate extremely low densities currently both within and outside of sequoia groves, and the fact that these are large areas with near zero canopy cover indicate that field observations corroborate the POSTSCRPT modeling that suggests that these areas are at significant risk of conifer regeneration failure and may convert to shrub and hardwood forest without intervention as stated in the EA.

The NPS has also clarified within the revised EA, page 21, that the reference densities developed for sequoia groves would not apply to the mixed conifer forest; rather, as described above, modeled potential regeneration failure combined with the current evidence of low mixed-conifer seedlings in these areas from field surveys indicate planting is administratively necessary to meet the purpose and need for action.

Because the NPS has confirmed that agency understanding of the scientific basis for action is valid, and because the commenter did not provide relevant information to substantiate claims to the otherwise, the NPS concludes that this concern was adequately addressed within the revised EA.

E5. Concern Statement: Methods of Field Surveys. One commenter 1) critiqued the time of year when the NPS gathered some of the regeneration data, 2) suggested the NPS sampled only a subset of plots in regeneration surveys completed in 2023 (which would have biased the results), and 3) the NPS impacted the results of the regeneration surveys by trampling seedlings during the field surveys (which, again, would have biased the results).

Representative Quotes

"many of your plot surveys were conducted too early in the season this year to see 2023 sequoia seedlings (so your 3863/acre figure will be an underestimation)…"

"…on June 29th we noted that many of the 2023 sequoia seedlings had just emerged from the ground days earlier, and many still had seed coats attached; some were still just under the needlecast. Therefore, there is no question that your "mid-June 2023" surveys, referenced on p. 27 of the EA, would have been too early and would have missed most of the 2023 sequoia seedlings."

"You would need to re-do the surveys in Redwood Mtn. and Board Camp in July or August to get a complete and accurate count."

"we have visited several of the Park's Redwood Mountain Grove plots so far and a troubling pattern seems to be emerging, wherein plots for which Park staff found very few sequoia seedlings in 2022 seem to have been surveyed in 2023, along with extensive evidence of trampling and boot prints, while plots with high densities of sequoia seedlings in 2022 appear not to have been visited in 2023, based on the absence of any boot prints, such as REMO_10...This suggests that biased sampling of plots may be occurring in 2023, which is a major concern since the nature of such bias would lead to a large under- reporting of sequoia seedling density for 2023."

"We visited a couple of your field plot locations and found an extreme level of trampling by your field crews within the plot boundaries, and extending for a couple of meters beyond plot boundaries. We could not find a square foot of area that hadn't been severely trampled and essentially denuded in one particular plot, while just outside of this plot there was abundant vegetation cover and abundant sequoia seedlings--tens of thousands per acre--but almost no vegetation cover and no seedlings within the plot."

"Whether it is due to innocent mistakes and carelessness, or otherwise, your 2023 field surveys are not even remotely close to the reality of the density of sequoia regeneration in the high-severity fire areas of Redwood Mtn. Grove, if you are claiming that there are currently less than the 4,266/acre that the EA claims existed last year in this area."

NPS Response

The field data collected to evaluate the need for action and that is presented for context in the EA was designed, collected, and analyzed using agency scientific standards. Study design was developed by USGS to create a spatially representative, unbiased sample. Data was collected under supervision and direction of long-term researchers and experts in sequoia ecology who used standardized methods and scientifically rigorous sampling protocols that have been implemented for decades. Credentials of these PhD scientists at NPS, USGS, and USFS are well established in the scientific research literature and their research has demonstrated scientific rigor through the peer-review process. Both Stephenson et al. 2023 (in preparation) and Soderberg et al. 2023 (in review) have undergone USGS peer-review (which meets NPS peer-review standards) and the data collected post-fire in the project area used in Soderberg et al. 2023 (in review) has additionally gone through USGS peer-review and data release process.

Concern sub-issue 1: Timing of regeneration surveys

To clarify the timing of surveys, NPS plots in Redwood Mountain were initially sampled in September of 2022 and re-sampled starting June 21, 2023. The resurvey was completed by July 18, 2023. There is no perfect time to sample regeneration as seeds are germinating and dying through time. Sampling early in the season will miss some seedlings but also count them before many die due to heat and drought. Thus, while a commentor suggested that sampling early will result in a significant undercount of 2023 seedlings, it might equally be expected to result in an overcount by not capturing subsequent summer mortality.

The NPS sampled in June and July partly due to crew availability and partly because the NPS wanted to be sure to be able to identify new and capture the most germinants (which is very difficult to do once cotyledons fall off which can happen quickly) and because the NPS wanted to capture the most germinants. Based on previous studies, specifically Stark (1968a) NPS assessment was that a mid-June to mid-July sampling period would capture the majority of germination but would be before the majority of mortality started to occur and would still be within the identification window when cotyledons were still on the seedlings.

Previous studies do not provide evidence that the survey timing used by NPS would result in a significant undercount of sequoia seedlings present on the site. For example, Stark (1968a) did a comprehensive lab and field study of germination conditions favoring giant sequoia and stated, "In general, field moisture and temperature conditions favor germination in April and May, and sometimes in September in the Central Sierra Nevada (Table 2)… Many seeds planted in the open in June, July, or August failed to germinate because of heat damage and rapid drying even when water was added daily." Although Table 2 in Stark 1968a shows seedling germination over three years in July, August, and September ranging between 0 and 38.2% of seeds put out in trials, the methods indicate that these seeds were watered in the field which likely increased germination over what would occur naturally. Further, Stark's own conclusion was that the best conditions in the field for seed germination were April and May, as quoted above. Additionally, Harvey and Shellhammer in a report to NPS that contains monthly seedling counts from the first three years of their study—the only study to individually tag and track sequoia seedlings over time—found that while seedlings continued to germinate over the summer months in year two post-fire, due to continued death, the total number of seedlings found continued to decline over the second summer as time since fire increased.

As summer goes on, soil conditions continue to heat and dry, making them more unfavorable for both sequoia seeding germination and survival (Stark 1968a, Stark 1968b). Combining Redwood Mountain surveys and Suwanee Grove surveys (conducted in July), preliminary analysis of the data collected for the project shows 33% of the sequoia seedlings present during the June/July surveys of 2023 are new germinants from 2023 and 67% are from seeds that germinated in 2022 and survived until the survey date in 2023. This is very similar to the percentage of 2023 regeneration of the total measured to what others are finding (the commenter whose comments are addressed in Concern Statement E6 share their own findings that 41% of seedlings are from 2023). Thus, based on previous studies and current data from both the NPS and others does not find that the timing of surveys is or is likely to, result in a significant undercount of the regeneration present two years post fire.

Concern sub-issue 2: Potential for bias with subsamples in 2023
All plots that were sampled at the end of year 1 postfire in Redwood Mountain Grove were resampled during the June/July 2023 sampling effort.

Concern sub-issue 3: NPS crews trampled seedlings thus reducing counts within plots
A small crew of trained field assistants sampled the 46 11.35-meter radius plots in Redwood Mountain grove in September of 2022 and late June through mid-July 2023. Resampling of giant sequoia regeneration began on June 21, 2023 and was complete by July 18, 2023. All 46 plots sampled in 2022 were resampled in 2023. There was no bias or subset of plots that were resampled in 2023.

With respect to trampling, the whole purpose of sampling is to evaluate regeneration and the need or lack thereof for management action. That said, some degree of trampling of vegetation surrounding a sample plot, regardless of size of the plot, will occur. Several mitigations were used to reduce trampling of sequoias seedlings during sampling. First, plots were sampled from the outside of the circle in, working in quadrants (1/4 of the circle at a time). This method is common in forest ecology and minimizes the amount of walking within the plot. Field surveys were also completed by experienced field crews who perform and are trained on conifer seedling sampling throughout forests of the southern Sierra Nevada. These field assistants took care to move vegetation out of the way with their hands in order to locate giant sequoia seedlings and other conifer seedlings and were especially careful to minimize trampling of seedlings within the plot. While it is reasonable that, despite mitigations and best efforts, some seedlings, as well as some herbaceous vegetation such as ferns and other forbs, may have been impacted by the boots of the survey crew, NPS staff observations when in the field with the crew in 2022 and when looking at plots after they had been sampled in 2023, was that extensive death of sequoia seedlings was not evident. The NPS did not observe large numbers of trampled seedlings. Regardless, any seedlings that may have been trampled during sampling would have been counted first due to the way the plots were sampled. Thus, any impacts of trampling would not affect survey numbers. Furthermore, because plots were distributed in a spatially balanced manner across the 350 acres of survey area and because of the care taken by the survey crew, the limited potential for seedlings to have been trampled and fail to recover would be unlikely to impact sequoia regeneration at the site for reasons outlined on page 16 in the revised EA.

E6. Concern Statement: Evidence of Regeneration in Redwood Mountain Grove.
Hundreds of commenters stated that, contrary to the data collected by the NPS and its research partners, independent scientists had documented high natural regeneration in planting areas, suggesting action is not needed. One commenter provided the NPS with additional citations and data that had been gathered by their team in Redwood Mountain. Because of this data,

one commenter states that the EA is outdated because others have documented high numbers of sequoia seedlings in Redwood Mountain Grove.

Representative Quotes
"I am asking you to withdraw and cancel SEKI's tree plantation and tree cutting proposal in Wilderness Areas within Giant Sequoia groves. The Park's prediction that sequoia seedlings would die and dwindle in the higher-intensity fire areas was wrong, and independent scientists are now documenting tens of thousands of sequoia seedlings per acre in these areas."

*"The team of independent scientists**…**gathered data in field plots along [four] transects in the large high-severity fire patch in Redwood Mountain Grove in the summer of 2023, and found an average of 27,161 sequoia seedlings per acre, with 41% of this from 2023, and sequoia seedling mortality of less than 3% (see attached Redwood Mountain Grove 2023 Field Data spreadsheet). York et al. (2013) (p. 8), upon which the EA heavily relies, says that sequoia seedlings that survive their first year have a 90% annual survival rate thereafter, and for at least the first two decades post-fire. Therefore, completely aside from the 2023 seedlings, the 2022 sequoia seedlings alone exceed 14,112 per acre and will have very high survival rates**…**We found abundant sequoia cones on the ground in high-severity fire areas and, even in the most intensely burned areas within the large high-severity fire patch, abundant cones are clearly visible atop the crowns of mature sequoia snags."*

"…the EA…is already outdated and eclipsed by significant new information and changed circumstances."

"In light of the 2023 sequoia seedlings far in excess of what the EA assumed would occur in the high-severity fire patches in Redwood Mtn. Grove and elsewhere, there is an important public need to determine the extent to which the current on-the-ground conditions in the groves proposed for planting are at odds with the representations and assumptions in the EA."

"…according to reports, they have done well at regenerating, particularly in severely burned area. We should not begin such an expensive and invasive effort (as described in the Document) without a reassessment."

NPS Response
In accordance with NPS policy, the NPS is relying on the best available science to assist park managers in addressing management needs and objectives. As described in responses to Concern Statements E1-E5, the EA establishes a decision-tree for intervention that is based on a robust dataset from previous fires (see responses to Concern Statements E1-E4) as well as robust field sampling within the areas considered for replanting (see response to Concern Statement E5).

During the public review period for the EA, independent researchers shared regeneration data that they had gathered in Redwood Mountain Grove in 2023. Notably, the average seedling density in their plots was far higher than that found in the survey plots sampled by USGS and UC Davis (these methods are discussed further in response to Concern Statement E5). While such high levels of regeneration within Redwood Mountain Grove could indicate planting is not necessary in those locations, the NPS reviewed the data presented by these independent scientists and determined that, while there are likely specific locations within planting areas that will not need to be planted given high levels of regeneration on site, the independent data is not applicable to the decision tree outlined in the selected alternative for the following reasons:

1. The independent data is from a small number of very small plots. While the commenters state that these plot sizes are appropriate for a semi-serotinous species and reduce seedling

trampling, numerous papers have shown that due to the high spatial variability of seedlings, it is important to both use large enough plots to capture variability and to overall sample a large area in order to achieve sampled mean values that represent the population (e.g. Clark et al. 1999 and Hanson and Chi 2021).
2. The total area sampled is very small (approximately 0.33 acres, 1,218m^2) in comparison to the large project area (over 400 acres). Thus, the sample area does not appear to be large enough to adequately assess field conditions (see Clark et al. 1999 for an evaluation of improved sample accuracy with larger areas sampled).
3. The sampling design, which is on a grid, will reduce spatial bias but may result in spatial autocorrelation and is not as robust a method for generating a spatially balanced sample as the methods used by USGS and UC Davis field crews.
4. The sampling methods involve a series of spatial bump ups where plot area is increased if no seedlings are found in a small area. The dataset provided to NPS shows 9 out of 31 plots were increased in size due to zero seedlings found in a smaller area. This may inflate the seedling densities over what is representative on the landscape.
5. The data collected and presented to NPS has not undergone peer-review. Thus, the methods used have not been independently validated.
6. No trend analyses or statistical analysis are presented nor are there are any uncertainties calculated or comparison to reference densities with associated probabilities that could be used to apply to the decision tree in the selected alternative.

Fundamentally, and as discussed in response to Concern Statement E1, the NPS is focused—not on individual areas of success—but rather the likelihood that stable populations can be largely restored across large areas of sequoia groves versus the likelihood that they will instead largely convert to shrub-dominated communities into the future. While the data shared by a team of independent researchers clearly indicates successful regeneration in portions of the grove, the data cannot be extrapolated to the same extent as the data gathered by USGS and UC Davis and upon which the NPS is relying to determine whether or not to plant in an area.

Finally, as also discussed in response to Concern Statement E1, a decision to replant some areas under the selected alternative is consistent with the precautionary principle. While planting sequoia seedlings in burned areas poses little to no risks to ecosystem function, not planting has the potential to cause a long-term alteration in ecosystem function. When dealing with an iconic species like sequoia that has a very small natural range and requires considerable time to reach reproductive stature, and is already under stress, promoting recovery, especially if those actions are reversible (e.g., through fire or mechanical treatment), is most closely aligned with restoration science and with the National Park Service Organic Act (1916).

E7. Concern Statement: Research Concludes High Severity Fire is Good for Sequoias.
One commenter questioned the need for action as new, emerging scientific research by independent scientists are finding that sequoia reproduction is higher in areas with the highest shrub cover and young sequoias are densest and growing by far the fastest in the high-severity fire areas. The commenter specifically referred to their research in Redwood Mountain Grove and Nelder Grove and referenced two other papers they had authored suggesting large patches of high severity fire are good for sequoia.

Representative Quote
"Our team of independent scientists also conducted a field plot study in the Nelder Grove in summer of 2023, at 6 years post-fire (Hanson et al. 2023, in review), finding that sequoia reproduction was densest, comprised by far the highest proportion of conifer reproduction, and

was by far growing fastest in the high-severity fire areas, including where shrub cover was highest and including areas hundreds of meters from the nearest live, mature sequoia seed source. Distance to live, mature sequoia seed source was not a significant factor in sequoia reproduction density at 6 years post-fire. Also, annual survival of the sequoia seedlings was 97%. Our results are generally consistent with those presented in York et al. (2013) and Meyer and Safford (2011), which are relied upon by Stephenson et al. (2023) and the EA. Every single study in existence that has addressed post-fire sequoia reproduction in high-severity fire areas versus low/moderate-severity areas, including those cited in the EA, finds far higher, and far faster-growing, sequoia reproduction in the high-severity fire areas. There are no studies in existence that support the assumptions made in the EA about loss of sequoias in high-severity fire areas, or that lend support to the notion that high-severity fire areas need to be artificially planted in sequoia groves. These are the very last places that would be in need of planting."

NPS Response

See the responses to Concern Statements E1-E3 for further discussion on anticipated regeneration following high severity fire.

The NPS has reviewed the literature concerning post-fire regeneration within sequoia groves, including a manuscript on Nelder Grove that was shared with the NPS during public scoping but has not been peer-reviewed or published in a journal or made available on a pre-print server for public access and review. While the author asserts that this research in Nelder Grove shows sufficient giant sequoia regeneration after high severity fire, the NPS decided not to incorporate the information in the manuscript into the planning effort, nor cite the manuscript in the EA for the following reasons:

1. The manuscript has not undergone peer-review and is not published. This is an indication that the manuscript does not yet meet scientific standards for use in NPS decision making. (The NPS is furthermore aware of substantial criticisms by two sequoia ecologists of the authors' methods and results which include significant methodological errors that undermine the study's findings (e.g., conflating size with age and inappropriate survey methods). See further discussion below.)
2. The manuscript had several significant methodological problems that could lead to overinflation of seedling densities, indicating that this data may not be representative of conditions on the ground in Nelder Grove and may not be scientifically adequate or meet the standards of scholarship. These issues included the use of plotless methods to obtain density estimates; the location of the majority of plots on the edge, not center, of the high severity area; and small sample size.
3. A paper reviewing field density methods found the method used in the study to perform poorly (Engeman et al. 1994).
4. Finally, the data which were collected are not presented in the context of a demographic model and make no analytical connection to mid to long-term sequoia population sustainability.

E8. Concern Statement: Number of Seedlings Planted Seem Superfluous. One commenter suggested that planting 100-400 seedlings per acre (as outlined under the selected action) would be superfluous and is not justified as this number does not align with the reference seedling densities described within the threshold. Others asked for additional detail on how the NPS would determine the additional number of seedlings to be planted in successive years.

Representative Quote
"If the thousands of two-year old seedlings and one-year old seedlings already present on Redwood Mountain are any indication, then the planting of 100 to 400 one-year old nursery seedlings per acre would seem to be superfluous and merely an intervention."

NPS Response
As discussed in the EA, planting densities for restoration will vary based on previous or reference proportions and densities of mature tree species, variations in landscape features (ridges and south facing slopes have lower densities than valley bottoms and north facing slopes), tree mortality immediately following planting and in future years, anticipated future wildfire, predicted hotter temperatures under climate change, and presence of natural regeneration. Generally, planting with fire-tolerant species at fewer trees per acre with spatial heterogeneity (clumping), will create a more fire and drought resilient forest (North et al. 2019, Van Mantgem et al. 2016).

As also described in the EA, sequoia seedling densities for replanting are much lower than the seedlings per acre used as the reference density. This is because of the extremely high survival rate of planted giant sequoia; York et al. 2007 found >90% survival over seven years. Therefore, a much smaller number of planted seedlings is required to put the groves on a trajectory to match density of mature trees before these wildfires. As also evident throughout the revised EA, the NPS will not plant additional seedlings in any of the six sequoia potential planting areas where regeneration has a 90% probability of aligning with the reference densities. The NPS has provided additional detail on seedling densities and thresholds for success in the revised EA and in response to Concern Statement E2. An example replanting plan can also be found in Appendix E of the revised EA.

As clarified via the revised EA, the NPS will determine whether to conduct a second planting based on a representative sampling of the initial planting. When survival in year one is below 70% the NPS may replant. In subsequent years, NPS may replant if mortality exceeds 10% per year.

E9. Concern Statement: Are These Areas Suitable as Future Forests? A few commenters suggested that the potential planting areas may no longer be suitable for sequoia groves given impacts from climate change, including increased frequency and severity of wildfires.

Representative Quotes
"…With advancing climate change, we don't even know if planting new sequoias in place of the burned ones would be productive..."

"Please do not plant trees. The climate is changing, which may mean that nature will know best what will grow and thrive in this area. Planting seedlings may mean failure."

NPS Response
These concerns are directly addressed in Chapter 2, Alternative 2 of the EA, under the Climate Assessment on page 30. The NPS will not plant in areas where evaluation of existing climate data indicates forest could not be supported in the future. However, as noted on page 30 of the EA, seedling planting density would be refined based on several criteria including current and future drought stress. Additionally, as discussed in the EA, part of the selected alternative addresses adaptation to future conditions, such as may be imposed by climate change through inclusion of increased genetic diversity in the planted seedlings.

E10. Concern Statement: Urgency of Action. One commenter challenged the NPS assumption that competition with shrubs requires urgent action.

Representative Quote

"The EA repeatedly expresses hesitation about waiting for more data, e.g., until at least summer 2024 field data can be gathered, and expresses the view that perhaps the high-severity fire areas in Redwood Mountain Grove and Board Camp Grove should be planted in fall of 2023, due to the expressed concern over the growth of native shrubs in the high-severity fire areas, and the assumption that shrub cover will impede or adversely impact natural sequoia reproduction or potential for planting. However, the available evidence indicates that this concern is unfounded. First, as discussed above, the only study to empirically investigate this question found that, by 6 years post-fire, sequoia reproduction density was highest in areas with the highest shrub cover. No empirical field studies providing contrary conclusions are cited in the EA regarding post-fire sequoia reproduction. Second, the EA itself (p. 37) contradicts this concern: The assumption of the need to remove other vegetation is based in the idea that this vegetation competes with the planted seedlings for light, water, or other needed resources. The conditions present in the large high severity areas proposed for replanting in this project may not meet this assumption. First, based on field observations completed to date, the proposed planting areas contain large patches of bare ground. These openings would be targeted for planting of seedlings. Second, given the complete removal of overstory canopy, these sites are at greater risk for high heat and soil erosion (surface erosion models showed high likelihood of significant soil loss). Shrub and forb cover has been shown to reduce surface temperatures, increase relative humidity, and improve seedling survival, and reduce soil erosion, all of which could increase survivorship of planted seedlings (Marsh et al. 2023; Marsh et al. 2022; Holmgren et al. 2012) (emphasis added). Third, York et al. (2013) (p. 14), upon which the EA heavily relies, contradicts this concern: "Fire-induced nitrogen volatilization could be at least partially compensated for following fires by rapid establishment of nitrogen fixing species (primarily Ceanothus spp.)…" Therefore, the evidence suggests that the precautionary principle should apply here and the Park should, at a minimum, hold off on this proposal at least until more and better data can be gathered at year 3 post-fire (and year 4 post-fire for Board Camp Grove), in the summer of 2024."

NPS Response

In the EA, the NPS discusses the many reasons why urgency is indicated—which include, but are not limited to, the potential for regrowing shrubs to compete with planted seedlings. As the commenter indicates, the NPS acknowledges in the EA that it is not known whether, in these never-seen-before high severity fire areas, shrub competition will occur and limit seedling growth. Rather, replanting soon after the fires is a risk mitigation measure to address this threat to seedling growth and survival, should it occur. Other factors also point to the importance of planting soon after fire to reduce risk and increase likelihood of success. These factors include: 1) having ample time for seedlings to grow large enough to survive future fires in the area; and 2) matching the timing of replanting as closely as possible to natural sequoia reproduction ecology to increase the similarities between planted seedling conditions and those that sequoias evolve under. Crew safety is also a factor in timing as the longer action is delayed, the more standing snags (i.e., dead trees) will be weakened and fail, endangering crew safety.

In contrast, the NPS has clarified elsewhere in this document (in response to Concern Statements E1, E2, E5 and in Appendix C of this FONSI) why waiting for additional survey results is not expected to produce a different outcome in the decision tree in terms of numbers of naturally regenerating sequoia seedlings being equal to or higher than the reference densities. And there is no published literature that indicates that sequoia seedlings will do well if planted or naturally seeded in areas of high shrub density such that planted seedlings would benefit by waiting another few years to initiate planting activities.

Finally, the NPS concludes that it is more in keeping with the precautionary principle to plant soon and prevent the potential unacceptable loss of areas of sequoia groves in areas where seedlings do not meet the reference densities than it would be to wait when no published data or analyses indicates that sequoia seedling numbers are likely to increase in future years in these areas for all the reasons discussed in E1, E2, E5 and Appendix C.

F. Comments Related to the NPS' Consideration of a Reasonable Range of Alternatives

Some commenters suggested alternatives, variations of alternatives, and/or additional components of alternatives to consider. Several commenters stated that the NPS had failed to consider a reasonable range of alternatives in violation of NEPA.

F1. Concern Statement: Outside Wilderness Only. Many commenters were supportive of replanting sequoias post-fire but requested that such actions only be taken outside wilderness. One commenter suggested planting in clear cut areas (which would be outside the park).

Representative Quotes
"…I actually support much of your efforts; just keep it out of existing wilderness."

" I feel that minimal replanting of sequoias may be necessary in SEKI NP. I am unalterably opposed, however, to any replanting in the John Krebs Wilderness portion. Wilderness is sacrosanct and must be left to regenerate naturally. It can also be a useful control to test the "no action" alternative."

NPS Response
The NPS considered but dismissed an alternative to only plant outside of wilderness for reasons explained on pages 36-38 of the EA.

F2. Concern Statement: Monitor Only. Numerous commenters suggested that the NPS take the opportunity to use these areas as a natural laboratory to monitor natural post-fire recovery.

NPS Response
The NPS considered an alternative to monitor regeneration and consider taking action later but dismissed this alternative for reasons outlined on pages 42-44 of the EA. The NPS also fully considered the impacts of a no action, monitoring only, alternative as described in Chapter 2, page 18, and fully analyzed impacts of this alternative in Chapter 3. The NPS determined that not taking action at this time would not meet the purpose and need for action and was likely to result in diminished sequoia groves, fewer sequoia trees, a severe fire effect feedback loop, diminished natural quality, and decreased dispersal opportunities for fisher when compared to other alternatives considered.

F3. Concern Statement: No use of Motorized Transport or Mechanized Equipment. One commenter had requested, during public scoping, the NPS consider an alternative that included no use of motorized transport or mechanized equipment, but stated the NPS had not considered or analyzed this alternative in the EA, as they suggested is required by NEPA.

Representative Quotes

"In our scoping comments we suggested that "Other potential alternatives should include no use of motorized transport or equipment."…However, among the three alternatives and those that were considered but dismissed, this reasonable alternative, which could meet the purpose and need, was not considered or analyzed. See EA, pp. 17-40. This is a fatal flaw, which makes the EA incomplete and violates NEPA. Surprisingly, someone in the Park Service must have thought that our suggested alternative was reasonable and feasible to meet the purpose and need because it was discussed in the Minimum Requirements Analysis as: "Alternative D: Only Plant Areas Safely and Feasibly Accessed by Foot, Stock, or Road Support." EA, Appx. D, p. 18. But such an alternative does not exist in the main body of the EA and its impacts have not been evaluated as required by NEPA."

"An agency must provide a reasoned discussion of alternatives that may avoid prohibited activity under the Wilderness Act. Alternative D [of the MRA] would avoid many of those prohibited activities. Moreover, the Park Service must, at the very least, explain why anything more than Alternative D is necessary, given that it could lessen the adverse effects on Wilderness character better than Alternatives B or C. If Alternative D lessens those adverse effects while leading to similar results (978 acres versus 1,130 acres planted), then the adverse effects from Alternatives B or C are unnecessary."

NPS Response

The Wilderness Act (Act) directs wilderness be administered so as to preserve wilderness character. Under Section 4(c) of the Act, certain activities in wilderness are prohibited, except as specifically provided for in the Act and except as necessary to meet minimum requirements for the administration of the area for the purpose of the Act. NPS policy directs that all management decisions affecting wilderness, including proposed 4(c) prohibited uses, be consistent with the minimum requirement concept. Managers have flexibility in identifying the method used to determine the minimum requirement as long as it clearly weighs the benefits and impacts of the proposal, documents the decision-making process, and is supported by an appropriate environmental compliance document. (See response D1 for further detail on conformance with the Wilderness Act.)

Under the regulations implementing NEPA, and NPS policy, the NPS is required to consider reasonable alternatives to recommended courses of action (43 CFR §1501.5(c)(2) and §1502.14). "Reasonable alternatives" are those alternatives that meet the purpose and need for action and are technically and economically feasible (43 CFR §46.420(b)), but when considering the full range of alternatives, the NPS may dismiss an alternative from further consideration for a number of reasons, including if the alternative is unable to resolve the purpose and need for taking action and/or if it is technically infeasible, or would result in too great of an environmental impact.

Per NPS policy, the MRA was drafted early on in the planning process in order to document NPS' application of the minimum requirement concept and to inform a course of action consistent with the Wilderness Act. In this early phase, the NPS considered an alternative (Alternative D of Appendix D) where action would only be taken in areas that could be accessed and planted without use of motorized transport or mechanized equipment despite the recognition that such an alternative would not involve action in wilderness sufficient to meet the identified administrative need or conservation goal (see pages 18-19 of Appendix D). As a point of clarification, the NPS has incorporated Alternative D into Alternatives Considered but dismissed in the revised EA (see page

36). This clarification in the revised EA does not modify the conclusions or analysis in the EA or the conclusion that a FONSI can be supported.

Related to the above, the NPS considered but dismissed from further analysis a number of alternatives or alternative components that would have used only non-motorized transportation methods (i.e., avoided use of helicopters) and/or non-mechanized tools (also described in section D of this document). As Section 2 of Appendix D explains, these alternative components were not considered or further discussed in the EA because they were unsafe or infeasible methods of achieving the need for administrative action or would have a greater impact on wilderness character. In response to the above concern raised by this group of commenters, dismissal of these alternatives has also been further clarified via the revised EA, though likewise does not modify the conclusions or analysis in the initial EA or the conclusion that a FONSI can be supported.

F4: Concern Statement: No Action Alternative and Monitoring. One commenter indicated that the No-Action Alternative should not include monitoring as this activity and any associated installations (which the commenter stated are not appropriate in wilderness) are indeed actions.

Representative Quote

"Note that it is unclear why the Park Service would install "600 small plot markers and 60 other installations" (no further description provided) under its No Action; alternative, which would also violate the Wilderness Act. These installations are actions, and they should not be included under the no action alternative."

NPS Response

The term "no action" may mean "no change" from a current management direction or level of management intensity (NPS 2015), which would be the case for proposals involving an update to an existing plan, policy, or ongoing management program—such as NPS' ongoing monitoring of post-fire conditions in sequoia groves (categorical exclusion 3.2.Y: day-to-day resource management and research activities). Evaluating a no action alternative that includes monitoring therefore complies with NEPA in that it is a day-to-day resource management and research activity needed to understand the conditions of giant sequoias, one of the park's fundamental resources, and is in fact a continuation of current management direction.

F5. Concern Statement: Delay Planting. One commentor stated that the NPS should have considered an alternative to delay planting until at least 2024 field surveys could be completed and, in not doing so, the NPS failed to consider a reasonable range of alternative. This is consistent with comments from many others that suggested more time is needed to monitor natural regeneration before determining whether there is need for action.

Representative Quote

"Given the foregoing, the EA failed to consider a reasonable range of action alternatives, which should have included an alternative to defer any planting until at least after 2024 field plot data could be completed, beginning no earlier than July 2024 in order to ensure that new, 2024 sequoia seedlings do not get missed or trampled before becoming visible."

NPS Response

The NPS considered but dismissed an alternative to monitor regeneration and take action later for reasons outlined on pages 42-44 of the EA. The NPS also fully considered the impacts of a no action, monitoring alternative (continue current management direction) as described in Chapter 2, page 18 and fully analyzed impacts of this alternative in Chapter 3.

Additionally, as explained in response to Concern Statement B1, regeneration data is not needed to inform a FONSI, and, as explained in response to Concern Statement C7, more data collection—such as regeneration surveys measured in year five post-fire—are not expected to align with the reference thresholds in Stephenson et al. 2023 (in preparation) if previous regeneration surveys had a low probability of aligning with the reference densities.

F6. Concern Statement: Plant Seeds. More than one commenter suggested that NPS plant seeds rather than seedlings. One commenter noted that the NPS considered this alternative but stated that the rationale for dismissing this alternative is confusing.

Representative Quotes
"If any actions were to be taken at all, it would be to sprinkle prepared seeds before the rainy season in the affected areas and see if any take - which is how nature regenerates itself."

"On pp. 35/75 and 36/75, under dismissed alternative #4 "Sow Seed to Re-Establish Seedlings", is written that GS seed "germination is typically very low under natural conditions (38% germination after one day on the ground…)." That DOES NOT SEEM LOW, and we often see massive germination of GS seed in natural conditions after fire. Then there is a statement about "naturally sown seedlings" which confuses. Then the use of the term "bushels". Is that a term used in forestry? The math is not laid out. The numbers are not clear. The argument seems to be wrong. As it is, the EA includes uncertainty whether planting might be needed at all, at least not in all areas. Maybe this idea of sowing seeds under proper conditions would be successful. Has it been tried with GS seeds?"

NPS Response
The NPS considered but dismissed an alternative to sow seed rather than plant seedlings and has added clarification regarding that explanation and rationale in the revised EA on pages 38-39.

F7. Concern Statement: Plant Other Species. Several commenters suggested planting a diverse range of species, including shrubs.

Representative Quotes
"Plant a high diversity of native species to help the ecosystem recover while the Giant Sequoias take their time to grow. Utilize fast growing shrubs and bushes to help provide soil stability while the forest takes its time to come back."

"If it's all one kind of tree~with no variety of conifers and deciduous trees, no shrubs, no ferns, no wild flowers~rhododendrons, wild roses, vine maples~whatever is Indigenous: it's not a forest."

NPS Response
As outlined starting on page 18 in the EA, the selected alternative includes planting a variety of native mixed conifer species in each area where planting will occur. The densities at which these species will be planted has also been clarified in the revised EA. The selected alternative will not include planting of other understory vegetation for reasons outlined on page 42 of the EA under Alternatives Considered but Dismissed.

F8. Concern Statement: After Care. Several commenters expressed concerns about the success of the planting efforts without any proposed preparation or after care, suggesting that the NPS should inoculate soils with fungi in order to promote survival prior to planting and/or continue to care for seedlings once they had been planted.

Representative Quotes
"make sure that the young trees are watered and well cared for to ensure the lowest possible mortality rates."

"To be planting and abandoning tree starts is the same as taking a one-year-old human and putting them out on the streets to survive."

"redwoods still have a fungal relationship with the trees and plants around them….One needs to consider interconnectivity at all levels."

NPS Response
Early in the project development stage, the NPS considered whether caring for tree seedlings beyond initial planting early on in the project would be necessary. Such care was determined not necessary to achieve project goals based on past successful planting efforts without after-care which have been conducted by other agencies, such as USFS, and as such would not align with the minimum requirement concept. The NPS considered but dismissed an alternative to inoculate soils for reasons outlined on page 42 of the EA.

F9. Concern Statement: Reduce Fuels. A few commenters suggested that—rather than plant—the NPS should instead take action to eliminate undergrowth to prevent future crown fires. Another commenter suggested that NPS use fire to reduce fuels to reduce the risk of future catastrophic fires.

Representative Quotes
"The only management should be to eliminate the overgrown undergrowth that fuels crown fires."

"With proper use of fire in the mountains servings as a preventative, preservative, and catalyst for new life, we can better manage the forests and their legacy. Misguided policies helped increase the fuel available leading to catastrophic fires, instead of manageable ones."

NPS Response
The EA discusses purpose and need for action in Chapter 1 of the EA. As described in Chapter 3 of the EA, and further detailed in the revised EA, the NPS has an active fuels management program to reduce understory fuels and will continue to manage fire within these parks for long term ecological benefit.

F10. Concern Statement: Assisted Migration. One commenter suggested that in addition to implementation of the selected alternative, the NPS should consider assisted migration of sequoia by planting north of the current range.

Representative Quote
"It would be wise to actively extend the range of Sequoiadendron northwards as the natural rate of forest migration cannot match the rate of climate change. Similarly, forest health may be enhanced by active selection of phenotypes that are more resilient in drought and warmer conditions. While such efforts may be beyond the scope of the current project, the possibility should certainly be kept in mind during all decision-making processes."

NPS Response
As the commenter states, assisted migration is beyond the purpose, need, and scope of the current project proposal and was therefore not analyzed in the EA.

F11. Concern Statement: Poor Use of Resources. Several commenters suggested that resources spent on this project would be better spent addressing other problems like climate change, fire prevention, care of remaining sequoia groves, or purchasing additional federally protected lands.

Representative Quotes
"I believe the forest can naturally recover, if in wilderness areas. Use the funds to purchase more federally protected land instead. Do not replant the forest."

"Lastly, there's a significant cost in proceeding; funding that could go elsewhere, like managing yet-to-be-burned forests areas. Why not visit this expensive experiment in 5 years and see what time allows. It's a bad, costly so close to these tragic events. No; not at this time."

NPS Response
The issue of addressing climate change lies outside the scope of the EA. The purpose and need for action, including protecting remaining groves is outlined on page 1 of the EA. The issue of other actions that could be or are being taken are described under cumulative effects, and as further described in the revised EA. Taking action under the selected alternative will not reduce resources dedicated to other actions, either authorized or considered, to continue to improve ecological health of forests within the parks in the future.

G. Comments Related to Impact Analysis

G1. Concern Statement: Wilderness Character. Several commenters raised concern that the NPS' analyses of impacts to wilderness character were inadequate or incorrect or that significant and lasting effects would occur.

Representative Quotes
"The discussions on how wilderness will be impacted are flawed and do not accurately state how severely the wilderness character of the treated areas will be impacted, not only during the treatment activities, but into the future. Unnaturally treating any element of the wilderness areas will alter the natural trajectory of recovery of the ecosystem for thousands of years."

"will cause significant lasting effects to Wilderness character."

"isn't the introduction of nonlocal genetics a long-term trammel?"

NPS Response
In the EA, and as further clarified via the revised EA on pages 67-70, the NPS qualitatively and quantitatively identified short- and long-term, direct, indirect, and cumulative impacts of the selected alternative on the four qualities of wilderness character for which status and trends are known, and concluded that, despite short-term adverse effects, wilderness character would be preserved. Based on public comment, the NPS considered the effects of two additional present and future actions that cumulatively effect the Sequoia-Kings Canyon Wilderness and John Krebs Wilderness; these cumulative impacts are incorporated within the revised EA but do not alter the conclusions of the impact analysis. The NPS also re-evaluated how impacts to wilderness character were analyzed and concluded that the NPS' analysis of impacts to wilderness character was conducted in alignment with interagency guidance (e.g., Landres et al. 2015) and NPS policy. No additional information was provided to support the concern that NPS' analysis was flawed or insufficient; the NPS concludes that impacts to wilderness character were sufficiently addressed through the EA and that the analysis is sufficient to support a FONSI.

For additional explanation concerning impacts to the untrammeled quality of wilderness character: The introduction of 20% nonlocal genetic material is considered a short-term trammel because the natural forces that shape genetic structure—birth and death rates as driven by natural selection, immediately begin to act on these individuals and on the population as a whole. Additionally, the proportion of nonlocal genotypes being introduced was selected in order to maintain the genetic structure already present. Thus, while the introduction of these genotypes that would not be present without human intervention is a short-term trammel, these individuals, and the genes they harbor, will increase or decrease in the population based on evolution by natural selection, not based on continued human interference or direction. Second, nonlocal genotypes of animal populations have been used in wilderness reintroductions repeatedly for the same reason (to increase the fitness of the population), and these actions have previously been evaluated as a short-term trammel; this evaluation is consistent with previous evaluations of similar actions.

G2. Concern Statement: Sequoia Seedlings. One commenter said that the EA inadequately described or minimized impacts to sequoias, particularly to sequoia seedlings that are naturally regenerating within potential planting areas. Concerns that commenters raised included impacts from trampling associated with the presence of crews on site and competition of newly planted seedlings with those naturally regenerating.

Representative Quote

"The EA states (pp. 17, 28) that 100 to 400 nursery-grown seedlings would be planted per acre in the areas in question, with undisclosed proportions of several tree species, only one of which would be giant sequoia. In our 2023 field data in the high-severity fire areas of Redwood Mountain Grove, 98% of the conifer seedlings are giant sequoias, similar to our findings at 6 years post-fire in high-severity fire areas of the Nelder Grove (See Redwood Mountain and Nelder Grove data spreadsheets). Currently, sequoias have a profound competitive advantage over non-sequoia tree species in the high-severity fire areas, unlike the low/moderate-severity areas, where non-sequoia species heavily dominate. Therefore, the EA proposes to undermine the dominance of giant sequoias in the high-severity fire areas by planting an undisclosed percentage of non-sequoia trees that would unnaturally compete with the naturally-regenerating sequoias, and undermine and impact natural succession and growth of natural sequoia seedlings in ways that the EA does not address, divulge, or acknowledge. The EA references planting plans which have not even been written yet, which means the public does not even yet know, based on the EA, what is actually being proposed where, and what the impacts would be."

"The EA does not meaningfully address or quantify the potential for the dozens of field staff and mules, walking and camping for several weeks in the high-severity fire areas, to trample and kill as many if not more naturally-regenerating sequoia seedlings per acre than the several dozen to a few hundred per acre the EA proposes to plant."

NPS Response

The NPS considered impacts to understory vegetation from alternatives considered within the EA; following public comment. The NPS additionally and specifically considered impacts to sequoia seedlings from crew presence and competition with planted seedlings via the revised EA and added mitigations to Appendix A to document how the NPS will minimize, if not avoid, impacts to seedlings. No additional analysis concerning impacts to seedlings is necessary to support a FONSI.

In addition to potential future impacts associated with the selected alternative, the NPS implemented mitigations to limit vegetation trampling during previous field surveys within potential planting areas and will continue to implement these mitigations in future field surveys and during planting activities, if implemented. These mitigations are described in response to Concern Statement E5 and have been included within the revised EA.

G3. Concern Statement: Genetics. Several commenters stated that the NPS misrepresented studies and/or drew inaccurate conclusions about the impacts to the genetics of a grove from the preferred alternative; several of these commenters indicated that the NPS had minimized the risks of planting up to 20% non-local genetic material. One commenter stated that NPS had failed to conduct an evaluation and analysis of the extent of local adaption to climate and other environmental conditions as well as the species' pattern of gene flow, which the commenter states is necessary to understand the risks of planting up to 20% of seedlings from the non-local community.

Representative Quote

"The EA (p. 18) outlines a type of genetic engineering scheme, proposing that up to 20% of the sequoia seedlings would come from outside of the groves where the planting would occur. The EA minimizes the impact of this on the unique genetic structure of each grove by citing to Aitken and Whitlock (2013) for the proposition that there would be no potential for disruption of the unique genetic character of each grove if the outside-grove seedlings were kept to 20%. But the EA misrepresents this study too. Aitken and Whitlock (2013) does not say that this 20% figure avoids potentially significant risk. It merely mentions (on p. 379 of the study) that another study used the 20% threshold as a means to avoid one adverse genetic impact, called "genetic swamping" (the loss of local genetic diversity), with the Florida panther, but does not say that this would be appropriate for a tree species like the giant sequoia. And, more importantly, the authors identify additional major genetic impacts, aside from genetic swamping, that are not minimized or addressed by the 20% threshold. In fact, the study says that any level of planting of individuals from other subpopulations creates a significant risk of "outbreeding depression", which can undermine the unique genetic character and health of the subpopulation (each individual sequoia grove, in the case at hand), and "disrupt local adaptation to nonclimatic factors". The authors of the study state that "Outbreeding depression may result from chromosomal differences between populations that cause partial or complete sterility (Frankham et al. 2011)." Aitken and Whitlock (2013) states that these severe adverse genetic impacts are particularly likely "if source and recipient populations have been long isolated". The study states that any attempt to avoid such serious genetic risks and impacts must be based on an extensive study and assessment: "To weigh the risks of AGF…we need to know the species' extent of local adaptation to climate and other environmental factors, as well as its pattern of gene flow." None of this extensive required assessment and analysis, including the extent and length of genetic isolation of the groves from each other and the level of gene flow, is analyzed or divulged in the EA, and there is no indication that this essential analysis has been conducted at all. Moreover, Aitken and Whitlock (2013) make clear that their suggestions about potential benefits of such genetic engineering experiments (which they call "assisted gene flow") is based on a hypothetical model and "simulations", making the impacts of the scheme highly controversial, with serious unknown risks. Another reason the "assisted gene flow" theory is highly controversial scientifically is that, when it is applied to real world populations, it can severely harm the genetic health and fitness of that population by introducing rare, deleterious alleles from other, normally isolated subpopulations (Hedrick and Garcia-Dorado 2016)—another impact that the EA does not mention, and which is unrelated to the EA's suggested 20% threshold."

NPS Response

The preferred, and now selected, alternative will introduce non-local seedlings from groves that are more arid and are large groves with known high genetic diversity, a practice known as assisted gene flow (AGF). AGF is not genetic engineering, which is the insertion of foreign DNA into the genome of an organism through molecular techniques (Gupta 2008). The practice of AGF is not controversial in the field of forestry and is practiced across Canada and the United States with conifer species (Ying & Yanchuk 2006, Gray and Hamman 2011, Handler et al.2018). As discussed on page 19 of the revised EA, the NPS based its decision to mitigate the small potential risks of AGF by limiting nonlocal genotypes to 20% of planted seedlings on the current state of research and best available science regarding sequoia genetics and guidance for reducing potentials risks (see Appendix E of the EA and Aitken and Whitlock 2013). In Chapter 3, pages 52-54, the NPS finds that because 80% of the seedlings would be sourced from the genetic neighborhood, and some of the genotypes and genetic structure of the original groves are retained through the natural regeneration, the risk of swamping (loss of genetic diversity currently existing in the population) is low (Aitken and Whitlock 2013). Appendix E of the EA contains a detailed analysis of the ecological conditions and genetic makeup of giant sequoia in the Southern Sierra as it pertains to this proposal, which directly addresses the commenter's concern about genetic analysis required prior to AGF.

This commenter cites three major concerns with AGF: 1) outbreeding depression, 2) loss of local adaptation to non-climatic factors, and 3) introduction of deleterious alleles. Outbreeding depression is a concern when populations are long divergent, which is not the case for giant sequoia in the Southern Sierra (Appendix E); thus, outbreeding depression is not a large risk for the proposed action and the risk is further moderated by using 20% non-local genotypes. Second, giant sequoia in the Southern Sierra are subjected to similar non-climatic local conditions, including pathogen and insect pressures, soil conditions, and photoperiods (Appendix E); thus, the loss of local adaptation to non-climatic factors is also not a high risk because non-climatic local factors are similar across the suite of groves being used for seeds in the selected alternative. Finally, the introduction of deleterious alleles from outside populations has only been shown in very small populations of mammals (Hedrick & Garcia-Dorado 2016); thus, this concern is also not a high risk for the proposed action. The NPS concludes that its analysis in the EA, which relies upon the expertise of a population geneticist in forest biology, sufficiently analyzed the risks versus benefits of inclusion of assisted gene flow in this project and that this issue does not require further analysis.

In addition to addressing the concern over local genetics being lost under the selected alternative, the NPS also conducted a full analysis of effects of components of the alternative on wilderness character—see pages 67-70 and the Minimum Requirement Analysis in Appendix D. Through the analysis, the NPS determined that, though introducing non-local genetic material would negatively affect the untrammeled quality of wilderness character—as well as opportunities for solitude, and undeveloped qualities—during project activities, it would not negatively affect these qualities in the long term (see additional discussion in response to Concern Statement G1). The analysis also concluded that improving genetic diversity may benefit the natural quality should genetic structure be the key to sequoia grove recovery.

As the commenters presented no contrary analysis or scientific information rebutting the analysis for impacts to genetics or untrammeled quality provided in the EA, and as the NPS has determined the selected alternative best meets agency mandates to preserve wilderness character in the long term, there was no need for further response to this comment.

G4. Concern Statement: Sequoia Groves. Several commenters were concerned that the NPS had either understated the potential for natural sequoia grove recovery under the no action alternative or overstated the potential for recovery under the action alternatives.

Representative Quotes

"On p. 45/75, under "Sequoia Grove Recovery" lines 1-2, is a VERY NEGATIVE idea…BUT on p. 48/75 under "Sequoia Grove Recovery" of Alternative 2 (the preferred alternative), is written the VERY POSITIVE…Forcing a "trajectory" is intervention. What if that intervention doesn't result in recovery?..."

"I reiterate once more that there is not a single scientific study which concludes that year-two post-fire sequoia or mixed-conifer seedling densities less than 14,112/acre will result zero sequoias or other conifers several years or more later, causing the "loss" of the sequoia grove, or conifer forest, in such areas. "

NPS Response

To address these concerns, the NPS has added additional qualifying and clarifying language in the revised EA. These qualifications and clarifications do not alter the underlying analysis or affect the NPS' conclusion that a FONSI can be supported.

G5. Concern Statement: Pathogens. Several commenters expressed concerns that pathogens may be spread by planting. One commenter suggested that the NPS analysis of impacts from potential pathogens should have been more fully considered in the EA and that the EA has mis-represented studies indicating that the risk of infection was low.

Representative Quote

"The EA (pp. 10, 29) acknowledges that nursery-grown tree seedlings have the potential to infect native forest sites with harmful and deadly root pathogens when seedlings are planted, but claims that there is no potential here to infect these sequoia groves with any invasive root pathogens, and therefore there is no significant impact that would require an EIS, ostensibly because a series of safety protocols would be followed that would eliminate any risk of such infections, citing Griesbach et al. (2012) for this proposition. However, the EA misrepresented Griesbach et al. (2012), which does not say that the risk of infection is eliminated by the protocols; rather, Griesbach et al. (2012) clearly states that significant risk of infection still remains, even with the protocols, which merely reduce the degree of the risk somewhat (the study says the goal "isn't perfection" but, rather, is merely "risk reduction"). Other studies on these root pathogens (see attached studies), which are spread to native forests from nursery-grown seedlings, indicate that the infection of native forest sites from these pathogens is common, even when protocols are followed, and the pathogens can kill natural seedlings, can severely stunt the growth of natural seedlings, and can in some circumstances lead to substantial mortality of mature conifers in the locations where planting occurs, which in this case could include mature sequoias. For example, Dobbs et al. (2023) notes that invasive pathogens from nursery-grown seedlings "can devastate hosts in natural stands after these pathogen species are carried on nursery stock and introduced into novel landscapes (Frankel et al., 2020)", and, "Once introduced, these pathogens are difficult to manage…" Another, James (2005), found that "Some level" of infection of native forest sites with invasive, harmful and deadly tree pathogens is "inevitable" when nursery-grown seedlings are planted. The EA improperly minimizes and downplays this major potential impact."

NPS Response

Non-native species and pathogens were each considered as issues but dismissed from further analysis in Chapter 1 of the EA due to the NPS' commitment to and implementation of Best

Management Practices (BMP) that are followed as standard practice across the discipline of ecological restoration to largely ameliorate the risks identified by the commenters. BMPs are further described under Alternative 2, on pages 31-32. That said, the NPS agrees that the dismissal language of these issues previously understated the level of risk. As well, the EA could have more fully explained the BMPs typically implemented and which nurseries would follow. The NPS has added clarifying and qualifying details in the dismissal language within the revised EA and has added the BMPs previously referenced in Appendix A, accompanying the revised EA. Although the EA has clarified the risks, the NPS finds that with BMPs in place, the level of risk and potential associated impact remains low. Reforestation efforts in mixed conifer forests in the Sierra Nevada are common and have been implemented throughout the Sierra for many decades. Sequoia planting efforts have also been carried out in groves and other forested areas for many decades and the NPS has found no documented evidence of introductions of pathogens or impacts to forest health from either sequoia replanting or general mixed conifer reforestation efforts.

G6. Concern Statement: Fisher. One commenter indicated that the EA insufficiently analyzed impacts to fisher as planting activities would indirectly shorten the temporal duration and spatial area of early seral forest habitat which fisher use for foraging.

Representative Quotes

"Moreover, the EA asserts that planting in these mixed-conifer forests is needed ostensibly to ensure future conditions for the ESA-listed Pacific fisher. However, the EA fails to recognize that Pacific fishers actively, and even preferentially (for females, in particular), forage/hunt in the complex early seral forest habitat created by high-severity fire patches, since such habitat has the highest levels of the small mammal prey upon which the fisher depends for survival and reproduction (Hanson 2013, Hanson 2015). The EA fails to recognize the unique importance of this complex early seral forest habitat phase of natural succession as key foraging habitat for the fisher, and the EA's planting proposal could shorten the temporal duration and spatial area of this fisher habitat, causing unknown impacts to fishers that are not analyzed in the EA."

"This does not address indirect but long-term, cumulative impacts, i.e., loss of habitat after denning. In addition, it does not acknowledge the importance of fisher habitat for foraging /hunting as detailed in Hanson, 2013 and Hanson, 2015. The potential impacts on fishers and their habitat – for feeding as well as denning - should be included in a more detailed environmental impact statement."

NPS Response

While early seral forest habitat may support a small mammal community that can support fisher foraging, many of the species (e.g., mice, chipmunks) using these areas are smaller bodied (fewer calories) than the larger tree squirrels (Douglas, Humboldt's flying, western gray) that rely heavily on tree cover either for food (e.g., cones for Douglas squirrels) or rest/den sites (e.g., trees with cavities for all species) (Carey et al. 1999; Steele 1999; Herbers and Klenner 2007; Zwolak 2009; Pyare et al. 2010; Wiles 2016; Pilgrim et al. 2023). Pilgrim et al. 2023 found that both Douglas and Humboldt's flying squirrel were important prey for fisher in the southern Sierra Nevada pre-tree mortality. Furthermore, large patches of early seral forest typically have limited overhead cover and few rest/den sites that provide important thermal and physical protection for fisher from inclement weather (heat and cold) and predators (Aubry et al. 2018; Zielinski et al. 2004; Jager et al. 2021; Thompson et al. 2021). For these reasons, there is no evidence that large swaths of early succession habitat (as is the case within and surrounding the 485-acre area where planting is being considered) are vital to fisher—instead, and as described in the EA, recent preliminary analysis suggest that extensive areas with limited tree cover may create barriers to movement (Meyer et al. 2022).

In addition, the project will not limit availability of early seral habitat due to the context of the selected alternative. While the NPS is considering planting in a 485-acre area of mixed conifer forest, this area represents less than 5% of mixed conifer forest that burned at high severity within the KNP Complex Wildfire in 2021. In other words, the action area is surrounded by thousands of acres of early seral habitat right now. Furthermore, any seedlings planted will be of the size expected 2-3 years post fire, therefore, though the NPS anticipates action will speed or promote recovery, the planted area will remain in early seral stages for years to come (i.e., the EA states recovery will take 50-100 years even with planting).

The NPS also notes (and as cited on page 2 of the EA) that wildfire driven habitat loss is one of the primary drivers outlined in the U.S. Fish and Wildlife Service's listing decision for the Southern Sierra Nevada distinct population segment of fisher. As the NPS further explains on page 2 of the EA, the area identified for planting was highly vulnerable to type conversion—which would negatively impact habitat connectivity and fisher in the long term. (See also, NPS response under E4.) Planting a mix of tree species in the potential planting area will help avoid type conversion to a shrub-dominated community and ensure the forest is restored to a forest structure that provides habitat that can meet the needs of key prey species (i.e., tree squirrels), create multi-layered canopy often associated with fisher occupancy (increasingly important as summer temperatures increase), and grow into trees used for resting and denning by fishers (which takes many years due to the size and decay needed to generate suitable cavities (e.g., Green et al. 2019)).

Given the above, the analysis within the EA, and the completed Section 7 consultation with USFWS, the NPS has determined that no additional analysis concerning a temporal or spatial loss of early seral habitat is necessary to support a FONSI.

G7. Concern Statement: Wildlife. Several commenters raised concerns that removing snags would harm a wide variety of species and components of the ecosystem.

Representative Quote

"Please…avoid the removal of snags. Snags are important perching areas for raptors furthermore woodpeckers create nesting sites in dead and dying trees when they excavate for bugs. These nesting cavities of woodpeckers provide the nest sites for many passerines including western bluebird and some flycatchers."

NPS Response

As described in Chapter 2, Alternative 2 of the EA, the NPS will minimize the removal of snags to that which is need for logistics and safety. The NPS also documents impacts from the removal of snags on wildlife in Chapter 2 but dismisses these impacts from additional analysis as each of the areas where planning will occur has thousands of snags present and removing up to a few snags in each location is not expected to limit this resource for wildlife. See discussion on pages 12-15 of the revised EA.

G8 Concern Statement: Loss of Scientific Study. At least one commenter expressed a view that the conditions brought about offered a unique opportunity for scientific study which would be lost if these areas were replanted.

Representative Quotes

"If the Park rushes ahead with planting plans, ignoring the fact that the entire landscape has changed due to massive 2023 sequoia regeneration, it would be an irreversible decision that would forever undermine our ability to understand how sequoia groves respond to larger mixed-severity fires, including large high-severity fire patches."

"The planting proposal, which covers nearly all of the larger high-severity fire patch areas in multiple sequoia groves, with the exception of some marginal sites, would prevent scientists from discovering how giant sequoias respond, in terms of natural succession, to larger high- severity fire patches over the next decade or two, and beyond. Large, landscape-scale wildfires are far from unprecedented in giant sequoia ecosystems; for example, very large wildfires spanning the entire Kaweah Watershed, and burning through many sequoia groves, occurred multiple times during the 1800s, prior to fire exclusion policies (Caprio 2016). But there were no scientists studying sequoia regeneration in such areas during the 1800s and, since then, fire has been excluded from the great majority of grove acres until recent wildfires, 2015-2021. Giant sequoia reproduction has not previously been researched in large high-severity fire patches like the one in the southern portion of Redwood Mountain Grove, or in groves that burned mostly at high-severity, such as Board Camp. This is quite literally a once-in-a-century scientific research and discovery opportunity—one that would be fundamentally undermined and lost if the planting proposal goes forward now."

NPS Response
The NPS agrees that the loss of large patches of sequoia groves to high severity fire have resulted in unique conditions. However, the opportunity to study recovery of large severely burned grove patches will not be lost once planting occurs. Rather, because the selected alternative includes a rigorous monitoring component and, if implemented, planting would occur in areas that are limited in spatial scope in comparison to the areas of high severity fire, there will be opportunities, both inside and outside the project area, to learn how both natural and planted seedlings recover over time and to learn about sequoia response to these fires. These areas can be compared to areas on USFS and NPS lands that are not being proposed or considered for planting (there is no shortage of large high severity patches of mixed conifer forest—of which sequoia groves are one type—where severe, and unrestored, post fire conditions will continue to be available for study) and to areas within the project area where seedlings would not be planted due to high local densities of giant sequoia seedlings. Furthermore, the NPS and research partners will continue to monitor and track recovery of these high severity patches—including both planted and naturally regenerated seedlings—for decades to come. In doing so, the NPS will continue to gain new and valuable scientific understanding into post fire recovery.

Ultimately, the NPS is required by law to preserve sequoias, endangered species, and wilderness character. Though scientific understanding plays a role in fulfilling legal mandates, development of further understanding cannot come at the expense of the resources themselves.

G9. Concern Statement: Cattle Trespass. Numerous commenters voiced concern over the presence of cattle within Redwood Mountain Grove, indicating that it is likely impacting seedlings and that their presence needs to be addressed.

Representative Quotes
"Why are these areas not being closed to grazing to protect the seedlings, as a matter of urgency?"

"Has the impact of cattle, which we observed directly and indirectly (stomping, excrement, browsing, etc.) throughout the designated area been adequately assessed in the EA? How much seedling loss (to date) has the NPS attributed to cattle, and if the proposed reseeding program were to be implemented, how much would cattle, if left unmitigated, undermine the reseeding effort?"

"In addition, there are dozens of cows grazing in the Wilderness area within the high-severity fire patch of the Redwood Mountain Grove where the Park is expressing concern about sequoia reproduction in the EA. [Others] took photos and videos of the cows, and cow droppings and soil damage. Some of the droppings are from 2022 and some from 2023, so this has been going on for

a long time, yet the Park has not removed the livestock, even as they trample and kill sequoia seedlings."

NPS Response
The NPS is aware of recent instances of cattle trespass within Redwood Mountain, and preventing recurring violations is a high priority. In accordance with 36 CFR 7.8(d)(1) stock and vehicular traffic are allowed to travel along the "road extending from the west boundary of Kings Canyon National Park near Redwood Gap to Quail Flat junction of the General's Highway and the road beyond" between national forest lands on either side of the General Grant Grove section of the park. But "Stock must be prevented from straying from the right of way." The NPS has been working with the USFS and their permittees to achieve and maintain long term compliance with regulations prohibiting cattle trespass on NPS lands.

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Appendix C: Response to Public Comments Concerning Scientific Basis for Purpose and Need for Action Received During Public Scoping

A number of scientific concerns were raised before and during the public scoping period between February 17, 2023 and March 19, 2023. After scoping had concluded, the NPS developed statements in response to the concerns, which were then independently peer-reviewed to ensure the response met scientific standards for accuracy and completeness and that the NPS' understanding of the literature is scientifically supported. The NPS asked Dr. A. Keith Miles of the United States Geological Survey (USGS) to coordinate the peer-review. The main purpose of this independent review on the scientific issues was to ensure agency consideration met scientific standards.

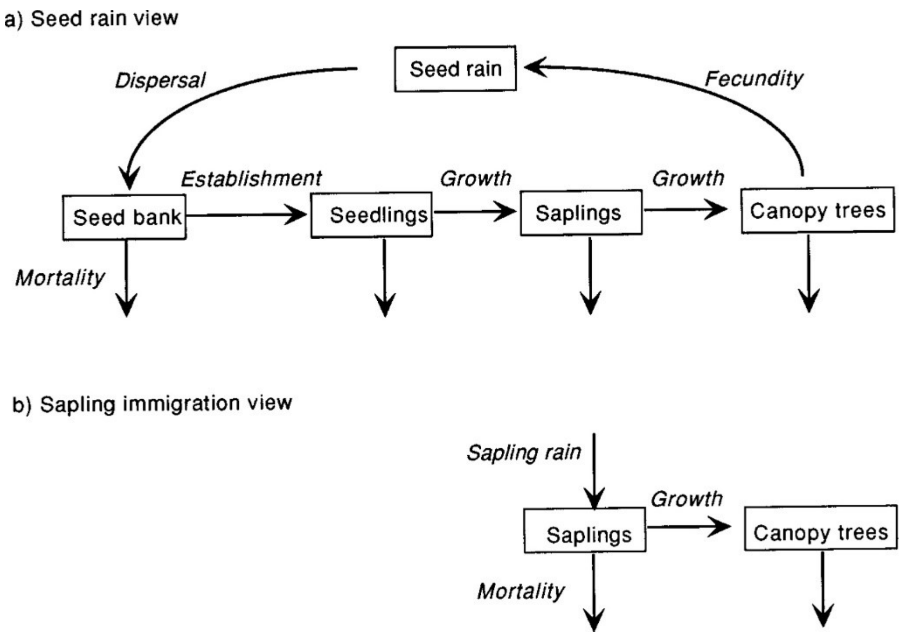
The NPS received the reviews in mid-August of 2023. Both independent peer-reviewers found NPS' responses to be scientifically sound and adequate. One reviewer also provided areas where they felt the agency response could be clarified or further developed with more citations. The NPS has addressed those suggestions in the following revised response.

These original concerns and the NPS' peer-reviewed responses are summarized below.

Concern 1: Post-fire sequoia reproduction occurs each year after the fire for many years (decades)—not just the first year (Nelder and Meyer papers are cited as examples). Since the NPS does not have data for many years post fire, the conclusion that there is not enough sequoia reproduction is incorrect.

Response: Assessment of future reproduction in trees is based on assessment of the critical life history stages that must be completed to result in successful reproduction. Forests may be a mix of recruitment limited and/or microsite limited. Jim Clark outlines a mechanistic model for trees that identifies these stages so that they can be evaluated:

1. Seed production (fecundity) resulting in seed rain.
2. Seed dispersal.
3. Seed bank.
4. Germination
5. Germinant survival.
6. Seedling survival until sapling size (see figure on next page from Clark et al. 1999).



All of the stages above may have been impacted by recent large scale high severity fire effects, such as are found within the project area as outlined below. Specifically, the major potential impact of these fires on two critical stages: 1) fecundity (due to the death of between 60 and 90% of the cone bearing trees within the project areas), and 2) potential impacts of high severity fire and subsequent drought on seedling establishment, survivorship and growth, and the reliance on giant sequoias on conditions immediately post-fire for successful germination and seedling survivorship, such as bare mineral soil (removal of litter layer through burning), sunlight at the ground surface, and more wettable and friable soils (Harvey and Shellhammer 1991, Stark 1968a, Stark 1968b). The combination of these factors all indicate that seedling densities are most likely to decline as the amount of time since the fire event increases; seedling numbers are not likely to increase dramatically in years 3, 4, 5 etc. since the fire event. And thus, if sampled estimated mean seedling densities do not meet reference densities by two years post-fire, they most likely never will. Below, the NPS provides additional citations and explanation regarding seed and seedling ecology to support this understanding.

Fecundity
Harvey et al. 1980 (Chapter 5) completed cone surveys and seed counts and calculated seed rain for intact sequoia forests. They also estimated at what age sequoia trees contribute the most to fecundity. They estimate, based on their field measurements, that a typical hectare of mature giant sequoia forest likely produces over, on average, approximately 1,590,000 seeds per year in the canopy (Harvey et al. 1980 page 48). Thus, the ecology of giant sequoias typically is not seed limited.

This ecology was seriously disrupted by the large areas of high severity fire effects observed within the project area. In the proposed project area in Redwood Mountain Grove, 90% of all large sequoias were killed by fire. These trees will no longer produce seed and thus the fecundity/seed rain going forward has been seriously impacted. Sequoia trees that were killed through canopy scorching, where heat-killed sequoia cones that are retained on the trees, can and will rain seeds down onto the forest floor possibly for several years after fire. It is unclear how long seeds may be held and survive in opened cones in the canopy. However, no additional seed is being produced in these areas and the dispersal kernel for giant sequoia (discussed below) indicates that significant amounts of seed will likely not be transported into the project area from other areas. The NPS estimated the loss of seed rain into these areas, once initial cones are depleted of seed, as follows: the typical number of seeds/cone x typical number of cones/mature tree x estimated number of trees lost (90% mortality x average density of large sequoias per acre x # of acres burned at high severity). For Redwood Mountain, this results in an estimated loss of 2,910,000,000 seeds lost that will not be replaced for hundreds of years. Harvey et al. 1980 used four feet in diameter or greater as an estimate of mature sequoias and estimated that trees don't reach that size for approximately 400 years.

The seed loss could also be estimated as an annual contribution of loss rather than a per tree loss. In this case, instead calculate seed loss as the loss of 1,590,000 seeds/per year/hectare and multiply by the hectares burned at high severity in the proposed project area in Redwood Mountain Grove (199.51 hectares). The estimate of seed lost annually is then 317,227,843. Regardless, high severity fire that killed such large numbers of mature sequoia trees clearly had an impact on the seed rain available to establish seedlings. Additionally, in groves where a high percentage of trees were killed by crown torching where the canopy was consumed, it is likely that the majority of seeds present in the trees were lost and were not even present in the first two years after fire to contribute seed rain. This is likely one of the contributing factors as to why seeding densities are so low in these groves, such as Board Camp grove (estimated mean seedling density two years post-fire is at 651 seedlings/acre, 1609 seedlings/hectare).

To summarize, for impacts and outlook with respect to fecundity: mortality data shows that future seed rain has been greatly impacted through the death of mature sequoia trees in the proposed project areas. This impact may already be severe and a limitation to regeneration in areas where the majority of trees torched (e.g., Board Camp, Homers Nose, Upper Dillonwood) but will certainly impact seed rain once any remaining dead cones in the canopy release their seeds.

Seed Bank

Sequoias do not have a seed bank but instead retain seeds in cones on living trees. In high severity areas where trees were incinerated, this cone bank was destroyed. Even in areas where trees did not burn completely, cones were opened by high heat.

Seed Release and Dispersal

Giant sequoia have semi-serotinous cones that can stay green and closed on trees for up to twenty years (Bucholtz 1938). Heat from surface fires may increase cone opening and increase seed rain immediately post-fire, and large amounts of seed have been observed falling in high severity patches post-fire (Kilgore and Biswell 1971, Harvey et al. 1980). Thus, seed rain may be highest immediately after fire even in areas where mature sequoia trees were not killed.

If seed is dispersed for sufficient distances, perhaps seed could reach the proposed project areas from adjacent areas that retain living trees. Jim Clark has created two dispersal kernels for giant sequoia based on USGS seed trap data. These dispersal kernels were used to support analyses in Clark et al. 1999 and Clark et al. 2021, although the kernels themselves are not part of the publications. Dr. Adrian Das at USGS received the latest dispersal kernel from 2021 from Clark (Clark to Das personal communication), and Dr. Das communicated to NPS that over 95% of all sequoia seed falls within 50 meters of the parent tree. Given the large size of the high severity areas in the proposed project areas (48 acres to over 400 acres in size), the likelihood of significant numbers of seeds being released and then dispersing into the project areas in the years after fire is very low.

Thus, the mortality of large sequoias from high severity fire effects may have now created a situation where these areas are seed limited in a way that they never were previously.

Seed Germination
Stark (1968a) studied the germination requirements of giant sequoia extensively. She found that seeds placed on unburned litter on or near the surface, and exposed to drying of air currents, did not germinate. Seed germination on mineral soil was the highest followed by seed germination by seeds partially covered on partially burned litter (98% as high as control), while seed germination on ash was fair (51% of control). Thus, litter must be removed by fire or other means to have successful germination. Litter then reaccumulates quickly post-fire, within the first few years (Parsons 1978).

Germinant Survival
Stark (1968a) found that seedlings seldom reach the surface if seeds are germinated 2.4 to 3.6 centimeters below the soil surface and, similarly, seedlings do not survive if they germinate on deep litter. Additionally, she found that seeds collected from cones on the ground in 42 groves showed 22.5% germination, yet others have repeatedly found few to no seedlings in unburned groves (zero seedlings in unburned control plots, Kilgore and Biswell 1971), indicating that although appropriate conditions for germination may occur in unburned groves, germinants may not survive.

Seedling Survivorship and Growth to Sapling Size
Stark (1968b) extensively studied conditions favoring seedling growth and survivorship of one year old planted seedlings in both the field and greenhouse. She found that seedlings grow best in full sun and that litter that fell on seedlings after germination reduced death from high temperatures. York et al. (2009) found that sequoia seedlings planted in opening on ash substrates also had more rapid growth than seedlings planted on the edge or adjacent to ash substrates. There was no effect on survivorship. The need for full light and the benefit of ash substrate on rapid growth again suggest that post-fire conditions are ideal for seedling growth.

Overall Patterns of Timing of Reproduction in Giant Sequoia from Other Studies:
Harvey et al. 1980 (Chapter 5) summarize the information available at that time regarding giant sequoia reproduction and ecology. They note several findings: 1) Sequoias are reliant on seeds from cones held on mature trees for reproduction (the species does not resprout); 2) Seeds germinate as soon as conditions are favorable, and seeds that germinate on litter and humus have very low survival; 3) Seeds may benefit from soil conditions immediately post-fire, notably increased penetration, wetting, and friability of soils after heating by wildfire. They conclude the seedling establishment section with the following statement, "We therefore infer that conditions are most favorable to giant sequoia reproduction for a period of two to three years after a disturbance to the forest floor. After that time very few seedlings manage to survive even though some seeds germinate each spring" (Harvey, Shellhammer, Stecker 1980, p. 54). Additional information and details on why the mechanisms of reproduction and existing evidence suggests that the vast majority of sequoia reproduction occurs in years one and two post-fire is summarized below.

Giant sequoias rely on fire for regeneration. Heat from fire opens the cones, and fire creates conditions on the ground that favor germination and establishment, including bare mineral soil (removal of litter layer through burning), sunlight at the ground surface, and more wettable and friable soils (Harvey and Shellhammer 1991).

How quickly these conditions disappear after a fire occurs is not clear. Few researchers have tracked seedling cohorts more than a single year after a fire. Harvey and Shellhammer tracked emergence and survival for cohorts the first and second year after fire, but their 1991 paper only reports relative survivorship standardized to 1000, not actual numbers of seedlings germinating. As also quoted above, in their 1980 summary book of their research on giant sequoia ecology, Harvey and Shellhamer report regarding seedling ecology that, "We therefore infer that conditions are most favorable to giant sequoia reproduction for a period of two to three years after a disturbance to the forest floor. After that time very few seedlings manage to survive even though some seeds germinate each spring" (Harvey, Shellhammer, Stecker 1980, p. 54). The only other dataset that we are aware of that tracked seedlings per plot for several years after fire are the NPS Fire Monitoring plots. These plots were summarized, analyzed, and peer-reviewed as part of the SEKI Natural Resources Condition Assessment on giant sequoias published in 2013 (York et al. 2013a, p. 10). The inset in Figure 2 of York et al. 2013a shows naturally regenerating seedlings in plots placed after prescribed fires. These fires vary in the fire intensity throughout the burn area and include areas of low, moderate, and high fire intensity. The mean at year one is in the 30,000 seedlings per hectare range, indicating that many areas surveyed contain high intensity burn conditions favorable for sequoia germination. The authors conclude, "Although sample size (and therefore certainty in the mean) decreases with time, there is a clear initial pulse of seedlings establishment followed by a steep decline during the first five years following fire" (York et al. 2013a, p. 10).

The data included in York et al. 2013a, as well as additional plots, were corrected and reanalyzed recently by Stephenson et al. (2023, in preparation). These data show a rapid decline in sequoia seedling densities from year one to year two which continues through the survey period, which goes for 20 years, postfire. Like York et al. 2013a, Stephenson et al. conclude that the vast majority of sequoia regeneration occurs in year one post-fire with the possibility of additional regeneration in year two followed by sharp declines in year five (FMH plots are measured at year 1-, 2-, and 5-years post-fire).

One commenter suggested that Meyer and Safford (2011) found multiple aged seedlings after both wildfire and harvest disturbances in giant sequoia groves, concluding that this study indicates that successful regeneration continues for many years after the disturbance. While the publication shows a wide variety of seedling size, it does not track or report seedling age. The NPS reached out to Meyer, the first author, to ask whether they aged seedlings and if not, if he felt that the size differences indicated different ages and were supportive of the idea that seedlings had continued to establish at high numbers for many years after the fire or harvest. This is what he said:

> Unfortunately, we did not age regeneration or young trees in our sequoia study from 2011 – we didn't have the funding or time to do this. So, I can't say anything about seedling/sapling/young tree ages with any certainty. But I can offer my thoughts, general observations, and some further clarifications.
>
> I highly suspect that the sequoia regeneration we observed from our study at Redwood Mountain and Case Mountain was derived from the first post-fire year with perhaps some minimal regeneration the second post-fire year – consistent with previous studies on post-fire sequoia regeneration patterns over time. I'm guessing that much of the variation in the heights and diameters of small trees and saplings of sequoias are due to differences in growth rates driven by the underlying site productivity and moisture/light availability – and not an indication of many different post-fire cohorts of sequoias. The latter seems like a bit of a stretch. A single post-fire cohort in year 1 (and minimal year 2 cohort) is a more parsimonious explanation than assuming repeated post-fire regeneration events in sequoia where new seedlings will have to establish under difficult circumstances – such as limited

> mineral soil with significantly more shading and greater shrub and other vegetation cover. Then there's the question of whether we can really expect all that much delayed seed dispersal by mature [sequoia].
>
> At Redwood Mountain in our 2011 study, there were a few patches where we found low densities of sequoia seedlings that could potentially represent a later post-fire cohort. However, these patches contained few seedlings and occurred mostly in the same cluster of plots with older sequoia regen representing about 36% of the sampling area (including plots with >1 [sequoia] seedling). So, even if we assume there was a second cohort of post-fire sequoia seedlings (which I wouldn't assume), they were: (1) quite limited in proportional density to older regeneration (~1% of all regen based on belt transects), and (2) limited in spatial distribution to those few plots where there was already existing, older sequoia regeneration (based on regen plots). In other words, smaller seedlings didn't just magically appear and establish in areas where there was no prior post-fire sequoia regen, even if we assume there was delayed [sequoia] seed dispersal several or more years post-fire.
>
> The same patterns were generally observed in the mechanically harvested groves. Although there are unique circumstances to each grove, such as Case Mountain where regen patterns were likely influenced by their unique treatment history and site conditions.

One other piece of evidence suggests that conditions for successful giant sequoia establishment rapidly disappear following fire. Multiple studies have shown that post-fire areas that have bare soil and, preferably soil heated by fire, are the areas where the greatest number of sequoia seedings are observed one year post-fire (Harvey, Shellhammer, Stecker 1980). This indicates that these conditions, including bare soil, are critical to giant sequoia seedling germination or survival. Additional studies have shown (reviewed in Harvey et al. 1980) that seeds that germinate on litter have high mortality rates from desiccation.

Although some sequoia regeneration is possible for several years post fire, the NPS understands that most regeneration occurs within the first one to two years post-fire, and regeneration several years post-fire in areas without regeneration within the first two years is highly unlikely given the following summary of the above information:

- Sequoias reproduce from seed that comes from cones held on trees (reviewed in Harvey et al. 1980).
- Seedlings do not show dormancy and germinate as soon as they become wet (Stark 1968a and reviewed in Harvey et al. 1980).
- A large seedling pulse occurs one to two years after fire (reviewed in Harvey et al. 1980, York et al. 2013a, Stephenson et al. 2023) (see above for mechanisms on why this is).
- Seeds that germinate on litter or humus have very high mortality rates (Stark 1968a and reviewed in Harvey et al. 1980).

Concern 2: Sequoia reproduction is the most abundant in high severity areas. Recent high severity fire in sequoia groves is therefore not concerning and no action is needed.

Response: Data collected after prescribed broadcast burns and pile burns indicates that giant sequoia seedling germination and survivorship is often the highest in localized areas of high fire intensity and resulting high fire severity. This is the conclusion of Harvey and Shellhammer (1991) and is also discussed in Harvey et al. (1980) and Stephenson, Parsons, and Swetnam (1991) as well as other studies and publications. High fire intensity burns up litter, heats the tree canopy resulting in increased cone opening and seed deposition, and in areas where fire severity is higher, results in canopy opening and increased light to the forest floor through the death of some of the canopy trees such as white fir or incense cedar. All of these conditions appear beneficial for giant sequoia reproduction and survival and have, in the past, resulted in successful establishment of giant sequoias. The NPS does not dispute the statement that giant sequoia reproduction is often the most abundant in high severity areas.

The issue of concern with recent fires, including the KNP and Castle fires, is the scale of high severity patches observed after the fire. Since giant sequoias rely on seed—dispersed from cones retained on living giant sequoia trees—to establish seedlings (sequoias do not resprout and do not have a soil seedbank), if 1) areas exist where no living giant sequoia tree remains and 2) seed dispersal is limited in distance, and 3) seed rain and resultant seedling germination and survival are not sufficient immediately post-fire (see discussion above for estimates of lost seed production due to mature sequoia mortality), then the opportunity to reestablish sequoias in the burned area is limited, if not lost entirely. In summary, it is not just about the low count of seedlings as of 2022, it is also about the depletion of future potential seed input, as well as the recovery of an unsuitable organic seedbed and competing vegetation which is expected to decrease any future seed germination and seedling survival.

To address issue Number one (areas with no living giant sequoia trees), the NPS performed field surveys and resampling sequoia tree inventory trees where possible. This data is summarized in Soderberg et al. 2023, in review, and shows that many contiguous areas exist where no living sequoia trees remain. To address issue Number two (limited seed dispersal in sequoias), there are four lines of evidence in giant sequoia ecology that indicate that the vast majority of seed dispersal is over very short distances.

1. Sequoia groves show fine scale genetic differentiation on the scale of one hundred to two hundred meters (DeSilva and Dodd 2021). This genetic differentiation at a local scale indicates limits in genetic mixing which could be the result of limited seed dispersal.
2. Second, as described in response to Concern 1 above, Clark et al. 2021 summarized and analyzed seed trap data from USGS plots containing giant sequoias and used this data to create a seed dispersal curve for the species. This curve indicates that over 95% of all seed lands within 50 meters of the parent tree (dispersal kernel from Clark pers. comm. Used in Clark et al. 2021).
3. Third, researchers such as Rundel have looked for grove expansion at the edges of existing groves and have found no evidence of groves expanding (summarized in Harvey et al. 1980). This may be due to abiotic or other biotic factors, but especially after prescribed fire or wildfire, it may also indicate a lack of longer distance dispersal.
4. Finally, the seeds do not contain any mechanisms for animal dispersal or other forms of long-distance dispersal, and they do not have good dormancy. All of these factors lead us to conclude that the vast majority of seeds do not travel far from the reproductive tree and that, in order to get the large number of seeds required to re-establish a stable reproducing population, you need reproductive trees in close proximity.

For information on the NPS' evaluation of whether current seedling numbers are sufficient, see below.

Concern 3: How is the NPS measuring seedling density in these post-high severity fire areas?

Response: Immediately after the Castle and KNP fires (year one post-fire), NPS and partner scientists visited some of sequoia groves that burned in each fire. Site visits were concentrated on areas where remotely sensed imagery indicated large areas of high fire severity within a sequoia grove but also included low and moderately burned grove areas. These field visits were limited by fires and smoke. Initial post-fire site visits for the Castle Fire included Upper Dillonwood and Garfield Groves as well as Board Camp Grove. During these visits, the NPS and partner scientists did not see very many sequoia seedlings and nowhere near the densities that the NPS and partners have observed after other wildfires and prescribed fires. Based on these observations, NPS staff worked with USGS to design and carryout mortality and seedling density surveys in six groves and a fisher habitat corridor where satellite imagery indicated large areas of high severity fire effects following the KNP and Castle Fires. These surveys were carried out in Board Camp two years post-fire; Redwood Mountain, Suwanee, and New Oriole Lake Groves and the Fisher Habitat Corridor one year post-fire; and work is continuing in 2023. All KNP groves will be surveyed a second time to detect year two sequoia seedling cohorts, and the unsurveyed Castle Fire groves (Dillonwood and Homers Nose Groves) will be surveyed during the summer of 2023. The methods involved stratified random placement of 11.7- or 17.25-meter radius round plots throughout the high severity portions of large groves (Redwood Mountain Grove) and throughout the entire grove for smaller groves (Board Camp, Suwanee, and New Oriole Lake Groves). Plot size was dependent on seedling density and was designed to avoid large numbers of zero values and to encompass spatial variation in seedling density. The full methods and results can be found in Soderberg et al. 2023 (in review, data has been reviewed by USGS according to standards for data release) and are reported below.

To survey post-fire regeneration, the NPS placed plots throughout the Board Camp, Suwanee, and New Oriole Lake groves and within high severity burn regions of Redwood Mountain Grove (areas with >75% basal area loss, Rapid Assessment of Vegetation Condition after Wildfire (RAVG) 2022; https://burnseverity.cr.usgs.gov/ravg/) using the Generalized Random Tessellation Stratified (GRTS) algorithm (Stevens & Olsen, 2004) with an equal probability stratified sampling design (Figure 2). The NPS used RAVG initial assessment (generally ≤45 days after fire containment) data based on the relative differenced normalized burn ratio (RdNBR; Miller & Thode, 2007) for the sampling design because extended assessment data (growing season following the fire) was not available before sampling commenced. However, the two metrics are largely consistent (Miller & Quayle, 2015). Plots in Redwood Mountain were limited to high severity areas because the large size of the grove made a full sampling impractical and high severity areas were of greater concern to resource managers based on previous studies of postfire conifer regeneration in Sierra Nevada mixed conifer forests (Shive et al., 2018).

The NPS surveyed plots in the 2021 SQF fire-affected Board Camp grove on April 27-28, 2022. The NPS surveyed the 2022 KNP fire-affected Redwood Mountain, Suwanee, and New Oriole Lake groves within a 6-week span on Sept. 1-7, Sept. 25 – Oct. 5, and Oct. 12, 2022, respectively. During field sampling, plot locations were found and recorded with a high-accuracy GPS device (Javad Triumph-2, Eos Arrow Gold GNSS Receivers). At each site, the NPS tallied seedlings within fixed radius plots (Board Camp: 17.84m radius, 1/10thha, 20 plots; Redwood Mountain: 11.35m radius, ~1/25th ha, 45 plots, 17.84m radius, 1/10thha, 1 plot; Suwanee: 11.35m radius, ~1/25th ha, 30 plots; New Oriole Lake Grove: 11.35m radius, ~1/25th ha, 20 plots; total sampled area: ~6 hectares). Generally, a plot radius of 11.35m was used, with an increased radius of 17.84m used when seedling counts were sparse (i.e., entirety of Board Camp grove, when ≤2 seedlings were counted within initial 11.35m plot). Any tree less than 1.37m in height was considered a seedling, though no seedlings in these surveys exceeded 30cm tall. Given that (1) sequoias very rarely regenerate without fire (Haertsveldt et al., 1975, Shellhammer & Shellhammer, 2006), (2) severe fire likely killed all existing seedlings, and (3) the small stature of all the seedlings counted, the NPS were confident that all seedlings had recruited postfire. In Board Camp, since sampling occurred two years after the fire, existing seedlings could have established in the first year after fire (first cohort seedlings) or in the second year after fire (second cohort seedlings). At Board Camp, the NPS distinguished between cohorts based on the presence of cotyledon leaves, which can still be found on seedlings for some time after establishment. Based on the lack of cotyledon leaves on any Board Camp seedlings the NPS observed, the NPS found no evidence of second cohort seedlings in the Board Camp grove despite a robust sampling effort.

Our seedling surveys covered ~10.0%, ~4.3%, and ~5.5% of the total area in Board Camp, Suwanee, and New Oriole Lake groves, respectively. Within the much larger Redwood Mountain grove, ~1.5% of the high burn severity area was surveyed. Within the 20 plots in SQF (2020) fire affected Board Camp grove, the NPS counted 3221 seedlings across ~2.0 ha of census area. None of the seedlings were identified as second cohort (germinated the second year following fire) strongly suggesting very little additional regeneration in the second year after the fire. Within the 46 plots in Redwood Mountain grove, the NPS counted 19282 seedlings across ~1.9 ha of the ~350ha of high severity burn area. Within the 30 plots in Suwanee grove, the NPS counted 14239 seedlings across ~1.2 ha. Within the 20 plots in New Oriole Lake grove, the NPS counted 13025 seedlings across ~0.8 ha (Table 1). In general, seedling surveys within the KNP (2021) affected Redwood Mountain, Suwanee, and New Oriole Lake groves yielded substantially higher numbers than those at Board Camp, as expected given that Board Camp only had only first cohort seedlings that had experienced at least an additional 6 months of exposure to mortality.

Concern 4: What level of regeneration is considered sufficient to reestablish groves and why? A commentor thinks there is sufficient regeneration present. The NPS does not. Why?

Response: In order to evaluate whether measured seedling densities in the proposed replanting areas are sufficient to restore giant sequoias in these areas, the NPS compared survey results, which generated both a mean seedling density and were used to generate a probability of meeting a reference density, along with calculation of reference densities for giant sequoias from an analysis of 42 sites in eight different sequoia groves which burned in 26 different fires spanning a 48 year period in Sequoia and Kings Canyon National Parks (Stephenson et al. 2023, in prep). These plots were analyzed in the context of a stable stage population model initially generated by York et al. (2013) and reanalyzed in Stephenson et al. 2023 (in prep). These analyses indicate that approximately 60,000 sequoia seedlings per acre are needed the first year post-fire which drops to approximately 40,000 sequoia seedlings/acre the second year post-fire. The NPS' observed seedling densities in the proposed planting areas are nowhere near these values.

- "Post-fire reference densities for giant sequoia seedlings" has been approved by USGS, and has been made publicly available in a cite-able form on the EcoEvoRxiv preprint server here: https://ecoevorxiv.org/repository/view/5457/, and
- David Soderberg et al. applied some of the results in a key related manuscript on "Assessing giant sequoia mortality and regeneration following high severity wildfire," publicly available in a cite-able form here: https://ecoevorxiv.org/repository/view/5433/

Concern 5: NPS plots are too small. Therefore, NPS' conclusion that there is not enough reproduction is false.

Response: Plot sizes were large and were adjusted in the field to ensure that the NPS did not have a zero dominated dataset as can happen when measuring seedling densities because they are so patchy. The NPS used 11.75-meter diameter and 17.84-meter diameter plots. Smaller diameters were used if seedings were encountered within this radius. If 11.75-meter plots had zero seedlings, then the NPS increased the plot size to 17.84 meters in diameters. The NPS are aware of the methodological and analysis issues associated with using plots that are too small to capture the scale of natural variation in regeneration and the NPS designed the sampling and analysis approach to address these issues.

Seedling density is often highly variable in space and can be spatially clustered (see for example, Ziegler et al. 2017). There have been a number of analyses of the best way to sample spatially variable clumped distributions such as forest regeneration including Clark et al. 1999 and Hanson and Chi 2021. The general conclusions of these two studies and others that larger plots, more plots for a greater sample area, and samples distributed across multiple sites, for a longer duration improve the accuracy of the samples to estimate the population mean. USGS designed our sampling protocol to ensure that individual plots were large enough to capture regeneration and include the scale of natural variation, that samples were spatially balanced and randomly distributed within the proposed project areas, and that the total number of plots added up to a relatively large proportion of the area being sampled. Generally, plots are larger than many seedling regeneration plots (which can be as small as one meter square) and the NPS sampled a larger area in total than many previous studies. The NPS used such large plots because seedling regeneration in Board Camp (which the NPS sampled first) was so low and patchy. The sampling design and data analysis that the NPS used was provided by USGS for NPS and was peer-reviewed by USGS and found to meet scientific standards.

In total, NPS seedling surveys covered ~10.0%, ~4.3%, and ~5.5% of the total area in Board Camp, Suwanee, and New Oriole Lake groves, respectively. Within the much larger Redwood Mountain grove, ~1.5% of the high burn severity area was surveyed. Within the 20 plots in SQF (2020) fire affected Board Camp grove, the NPS counted 3221 seedlings across ~2.0 ha of census area. None of the seedlings were identified as second cohort (germinated the second year following fire) strongly suggesting very little additional regeneration in the second year after the fire. Within the 46 plots in Redwood Mountain grove, the NPS counted 19282 seedlings across ~1.9 ha of the ~350ha of high severity burn area. Within the 30 plots in Suwanee grove, the NPS counted 14239 seedlings across ~1.2 ha. Within the 20 plots in New Oriole Lake grove, the NPS counted 13025 seedlings across ~0.8 ha (Table 1). In general, seedling surveys within the KNP (2021) affected Redwood Mountain, Suwanee, and New Oriole Lake groves yielded substantially higher numbers than those at Board Camp, as expected given that Board Camp only had only first cohort seedlings that had experienced at least an additional 6 months of exposure to mortality.

Concern 6: Seeds are dispersed by more than wind, including by animals, and can come from a long distance. Thus, NPS' conclusion that regeneration will not occur because living trees are not close is false.

Harvey et al. (1980) intensively studied birds and small mammals within Kings Canyon and their impacts on sequoia seeds and seedlings. They also review other published literature regarding animal impacts to sequoia seeds and seedlings. For other than Douglas squirrel (discussed below), they conclude that "birds and mammals exert little effect on giant sequoia seeds either on the ground or on seedlings. The principal reason for this appears to be their small size." Thus, the NPS don't find evidence that seeds are likely to be carried long distances by birds or small mammals.

Harvey et al. (1980) has a full chapter on the relationship between Douglas squirrel and giant sequoia. Douglas squirrel have been observed cutting and caching large numbers of sequoia cones by numerous authors (reviewed in Harvey et al. 1980). In their extensive, multi-year study of Douglas squirrel use of giant sequoias, Harvey et al. (1980) found that, similar to other places where they occur, Douglas squirrels were territorial with the heart of their territories being 1-2 mature trees, typically a large white fir and a large sequoia. Territory size varied from 0.69 acres to wandering over 2 to 4 acres in a year when squirrel densities were particularly low. Squirrel caches were located at the base of the tree from which the cones were cut or in nearby wet areas. Thus, the likelihood of Douglas squirrels occupying these high severity areas where the majority of living trees are dead seems very low (there is not sufficient food in the form of mature, cone-bearing sequoias and other conifers) and the likelihood of squirrels creating caches in these zones of high tree mortality that are significant distances away from living trees also seems unlikely. Even in intact forest, given the patterns of Douglas squirrel caches (near the tree they were cut from or in close by wet areas) it seems unlikely that Douglas squirrels would disperse seeds long distances.

In NPS' field data collection, the NPS did observe high densities of seedlings in some drainage areas, indicating that seeds can be carried downstream longer distances and deposited in drainage areas. Unfortunately, many of these seedlings were already being undermined by scouring or buried by erosion, so these sites may not be viable long-term. See the summary above for evidence that vast majority of seed dispersal is local.

Concern 7: Seedling survival rates will be high because most seedlings will survive in high severity areas which have ideal conditions for regeneration. The commenter also states the NPS is using the wrong seedling survival rates to calculate how many seedlings you need to reestablish a grove.

Response: The NPS disagree that natural seedling survival rates in the large high severity fire areas that are proposed for replanting will be high. Although the NPS agree that previous studies have found that sequoia seedling survivorship was highest in areas that had been pile burned and were thus potentially similar to high severity wildfire, given the large size of these high severity areas, it is unknown what the impacts of these conditions will be on sequoia seedling survivorship. This issue was considered and summarized in Stephenson et al. 2023 (in prep) and is quoted here:

> Do NPS reference densities – which, of necessity, reflect the effects of past mixed-severity fires during a more climatically benign period – provide a useful yardstick for judging seedling densities observed after historically large and severe wildfires? More specifically, considering the high death rates of sequoia seedlings during their first years and decades after germination (Harvey et al. 1980, Harvey and Shellhammer 1991, Shellhammer and Shellhammer 2006, York et al. 2013a), do we have reason to believe that the low seedling densities found in the severely burned portions of Board Camp and Redwood Mountain groves might still be adequate to eventually replace the sequoia populations that were locally extirpated by the wildfires? The NPS addresses this question by considering expected sequoia seedling survival relative to (1) the size of fire-created forest gaps, (2) the presence or absence of a post-fire leaf litter mulch, and (3) a warming climate.

Relative to small fire-created gaps (<0.1 ha), Demetry (1995) found that sequoia seedlings had greater average size (and thus growth rates) in progressively larger gaps, up to ~1.2 ha in size (the largest gap she sampled). Seedlings with higher growth rates, in turn, have higher survival rates (Harvey et al. 1980, Harvey and Shellhammer 1991). Relative to mixed-severity fires of the past, can the NPS thus expect higher average seedling survival within the very large (e.g., >10 ha, and even >100 ha) gaps created by recent wildfires? Not necessarily. Snow accumulation and retention are usually maximized in forest gaps of intermediate sizes (e.g., up to ~1 to 5 ha) (Golding and Swanson 1978, Troendle and Meiman 1984, Stevens 2017), which in turn maximizes snowmelt moisture available to sequoia seedlings. In contrast, gaps that are larger than ~1 to 5 ha, and particularly the very large gaps created by recent severe wildfires, retain less snow and melt out earlier (Stevens 2017, Gleason et al. 2019, Smoot and Gleason 2021, Hatchett et al. 2023), lengthening and deepening the summer drought experienced by the sequoia seedlings that germinate in those gaps. The earlier snowmelt in these very large gaps will likely be amplified by a warming climate (see below). The more severe summer drought in very large gaps – induced by earlier snowmelt – could be further exacerbated by the reduced relative humidity and increased temperature, solar radiation, and wind speed found in gaps (Ma et al. 2010, Bigelow and North 2012, Wolf et al. 2021). Certainly, within the very large gaps created by recent wildfires there will be many scattered microsites capable of supporting rapid seedling growth and high survival rates, but this does not mean that, at the scale of the entire landscape, seedling densities lower than our reference densities can be assumed to be adequate to regenerate the locally extirpated sequoias.

Sequoia seedling survival is lower when the soil surface lacks a layer of leaf litter (Stark 1968). In the absence of litter, soil temperatures can be up to 10ºC to 15ºC higher, and soil moisture at 10 cm depth as much as 25% to 60% lower – conditions that will typically contribute to increased sequoia seedling deaths related to soil fungi, heat canker, and desiccation (Stark 1968, Harvey et al. 1980). In forest gaps created by crown scorch – that is, where most trees were killed by the convective heat of a surface fire – the dried leaves (needles) of the dead trees quickly begin to fall and create a new litter layer that contributes to seedling survival. These were the typical post-fire conditions in the plots used to derive our reference densities. In contrast, during the recent wildfires some areas of sequoia groves burned in large, historically unprecedented crown fires that consumed most of the forest canopy. In these crown fire areas, reduced post-fire litter accumulation could contribute to reduced seedling survival relative to the post-fire conditions upon which our reference densities were based (cf. Welch et al. 2016).

Finally, temperatures have been rising in the southern Sierra Nevada (Edwards and Redmond 2011, Das and Stephenson 2013) and are expected to continue to rise (Gonzalez 2012). Even in the absence of directional shifts in precipitation, warming has already contributed to earlier snowmelt at the elevations where giant sequoias occur (Andrews 2013, Mote et al. 2018), which in turn lengthens the summer drought experienced by sequoia seedlings. In addition to lengthening the summer drought, rising temperatures increase the atmosphere's evaporative demand for water, thus increase drought severity (Williams et al. 2015, Williams et al. 2022). Young sequoia seedlings today and in the future are thus expected to experience, on average, longer and more severe drought periods – and associated reductions in survival – than those that were censused for our reference densities.

Given the preceding considerations, and until any new, compelling evidence might suggest otherwise, the NPS find no reason to believe that the Board Camp Grove and Redwood Mountain Grove seedling densities, which are significantly lower than our reference densities, can be assumed to be adequate to regenerate the locally extirpated sequoia populations.

Finally, the NPS would add that the dataset that was used to generate the reference densities comes from eight different prescribed fires which burned with a range of fire intensity, resulting in a range of fire severity. So, the dataset used to generate these reference densities included both high, low, and moderate severity fire areas and was not focused on low severity fire.

Concern 8: What is the scientific basis for planting in October? Planting in October will greatly reduce survivorship.

Response: Once site assessments are completed and site planting plans finalized, the NPS would move forward with planting seedlings as soon as possible—in the following fall or spring season—to establish seedlings prior to extensive regrowth of dense, tall, uniform shrub cover with the intent of mimicking, as closely as possible, natural post-fire conditions under which sequoia and other mixed conifer seedlings thrive. For this reason, the NPS would consider planting in Redwood Mountain Grove, Board Camp Grove, and the fisher corridor immediately to the south of Redwood Mountain Grove (where analyses indicate action is both necessary and warranted) as early as fall 2023. For any of the replanting areas though, the NPS could plant either in late October, just before the season's first snow, or in early spring, as sites become accessible and when soil moisture is highest, to improve chances of planting success. Although conifers are most often planted in spring, with hotter, drier summers becoming more frequent (see Stephenson et al. 2023 in preparation), fall may be a more effective planting time since it avoids the summer drought. For this reason, the NPS could plant in fall and/or spring. If determined planting is appropriate under the decision tree, the NPS would likely plant in Suwanee, New Oriole Lake, Dillonwood, and Homer's Nose Groves in spring or fall of 2024 or 2025.

Concern 9: One commenter stated they had observed a lot of seedlings—more than enough to reestablish 2.61 mature sequoias per hectare. Therefore, the NPS does not need to replant.

Response: See discussions above regarding how the NPS established reference densities for giant sequoias.

Concern 10: High severity fire is common and part of the sierran ecosystem. Therefore, this fire was within natural range of variation, was good for the groves, and needs no human action to repair because there was no damage.

Response: While the NPS agrees that high severity fire is part of the pre-Euromerican settlement ecology of Sierra mixed conifer forest and giant sequoias groves in particular, the spatial extent of high severity fire effects seen in the Castle and KNP fires as well as many other fires in the Sierra Nevada within the past decade is outside of the natural range of variation for giant sequoia groves and threatens their ability to successfully re-establish post-fire. Fires before Euro American settlement generated a large matrix where fire effects were of low to moderate severity with small opening where high severity fire killed canopy trees. These gaps ranged in size from hundredths of a hectare to up to a few hectares in size (Stephenson et al. 1991, Stephenson 1994, Stephenson

1996). In such fires, many large living sequoias remained within the surrounding forest matrix to disperse seed into the fire-created gaps. In the Castle and KNP complex fire, large areas of high severity fire were created that contain no living sequoias (KNP BAER report and SEKI replanting EA). Additionally, three fires, the Castle, KNP, and Windy fires, killed approximately 13-19% of the entire large sequoia population (Shive et al. 2022), an unprecedented negative impact to the giant sequoia population. These impacts to a long-lived, fire adapted species such as giant sequoia can be characterized as negative. And as one of the purposes of Sequoia and Kings Canyon National Parks is to perpetuate giant sequoia groves and ensure their longevity for future generations, these impacts can certainly be characterized as negative and potentially in need of repair.

Additional evidence that these recent fires are not within the natural range of variation and are having detrimental effects on forest ecology are summarized below. Taken from Soderberg et al. (in review, 2023):

> "Throughout western North America, changes in land use patterns combined with the effects of severe drought – specifically, over a century of fire exclusion and large-scale tree mortality events – have led to shifts in forest structure and fire regimes throughout fire-prone forest ecosystems (Stevens et al., 2017, Parks & Abatzoglou, 2020, Hagmann et al., 2021). A resultant increase in ground and standing fuels, coupled with increasing temperatures and aridity, have facilitated an increase in wildfire-affected landscapes across the western United States (Westerling, 2016), with profound fire-induced changes within forest ecosystems of California (Safford et al., 2022). In recent years, the southern Sierra Nevada mountains of California have been impacted by multiple fires of large extent that contained large patches that burned at high severity (Steel et al., 2022).
>
> Two of the largest recent fires within the southern Sierra Nevada, the SQF- fire of 2020 and the KNP-Complex fire of 2021 (hereafter referred to as the "SQF" and "KNP" fires) had cumulative burn areas of ~106,000 hectares, of which ~47,000 hectares were classified as 'high severity' (MTBS; www.mtbs.gov). While fire is an important and natural process in fire adapted forest communities such as those in the Sierra Nevada (Stephens et al., 2007) – facilitating important ecosystem functions such as fuels reduction, landscape heterogeneity, and regeneration – large patches of high severity fire are not typical for mixed conifer forests and can lead to deleterious ecological outcomes, such as reduction of seed source, biodiversity, and wildfire and climate resilience (Cova et al., 2022). Large wildfires are not absent from the fire records of California forests, but the severity and scale of recent fire events have been outside the historical range of variation (Keeley & Syphard, 2021, Safford et al., 2022, Stephens et al., 68 2022). As such, these fires have had negative impacts on forest structure and ecosystem services, including for species of special interest such as the giant sequoia (*Sequoiadendron giganteum*) (Shive et al., 2022). "

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