Sierra National Forest Post-Fire Conditions

In the past two decades, the Sierra National Forest has experienced multiple major wildfires that have caused extensive changes to the physical terrain, forest cover, wildlife habitat, native plant species, and recreational infrastructure. About 700,000 acres have burned or reburned, which is nearly all of the forest's unprotected acreage (the acreage not protected as wilderness). According to USFS reports, only 10 percent of its 1.4 million acres remains available for commercial logging, or about 141,626 acres.[1]

Fire	Year	Acreage
Carstens	2013	1,708
Aspen Fire	2013	22,992 *
French fire	2015	13,832 *
Willow Fire	2015	5,702
Rough Fire	2015	151,623
Sacata Fire	2016	2,100
Mission Fire	2017	1,035
South Fork Fire	2017	7,000
Railroad Fire	2017	12,407
Ferguson Fire	2018	96,901
Bullfrog Fire	2020	1,185
Creek Fire	2020	379,895*
Basin Fire**	2024	14,0023

*Creek Fire reburned Aspen & French Fire areas.
**The Basin Fire is currently burning (July 2024).

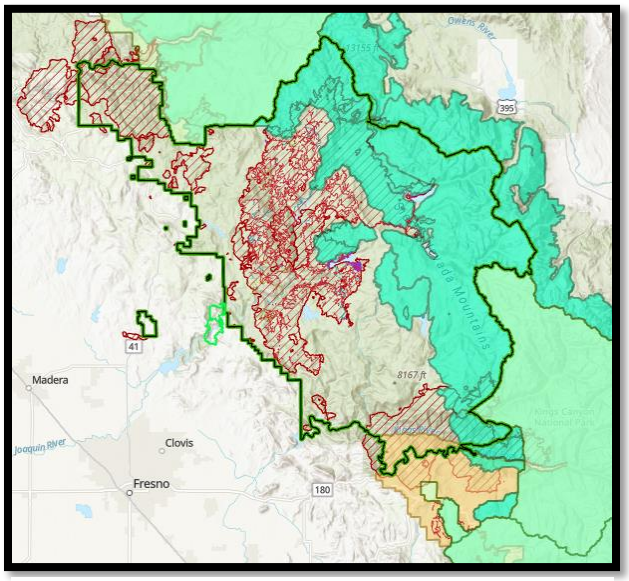

Figure 1: Fires in Sierra National Forest

The most significant of the recent fires is the Creek Fire, which burned 379,882 acres in the fall of 2020. It destroyed more than 850 buildings, led to the evacuation of more than 30,000 people, compromised air quality in the Central Valley, and resulted in damages exceeding $500 million,[2] while drastically altering the landscape.

All of these fires burned in thinned and logged areas of second-growth forest, while affecting only the perimeters of wilderness areas. Both the Aspen and the Ferguson Fires overlapped with the Creek Fire, which demonstrates that areas recently affected by a reduction in forest cover (e.g., fuels, trees, shrubs and native plants) cannot be assumed to be protected from wildfire despite the decrease in fuels. Current management actions that remove fuel, via logging, road-building or brush removal, may be creating conditions, which are increasing the frequency and severity of fires in the region.

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[1] Forest Service, Agriculture Department. "Draft Revised Land Management Plan for the Sierra National Forest, Fresno, Madera, and Mariposa Counties, California". Government. Agriculture Department, December 31, 2015. https://www.govinfo.gov/app/details/GOVPUB-A13-PURL-gpo69136

[2] Creek Fire. *CalFire*. https://www.fire.ca.gov/incidents/2020/9/4/creek-fire. Accessed 27 April 2024

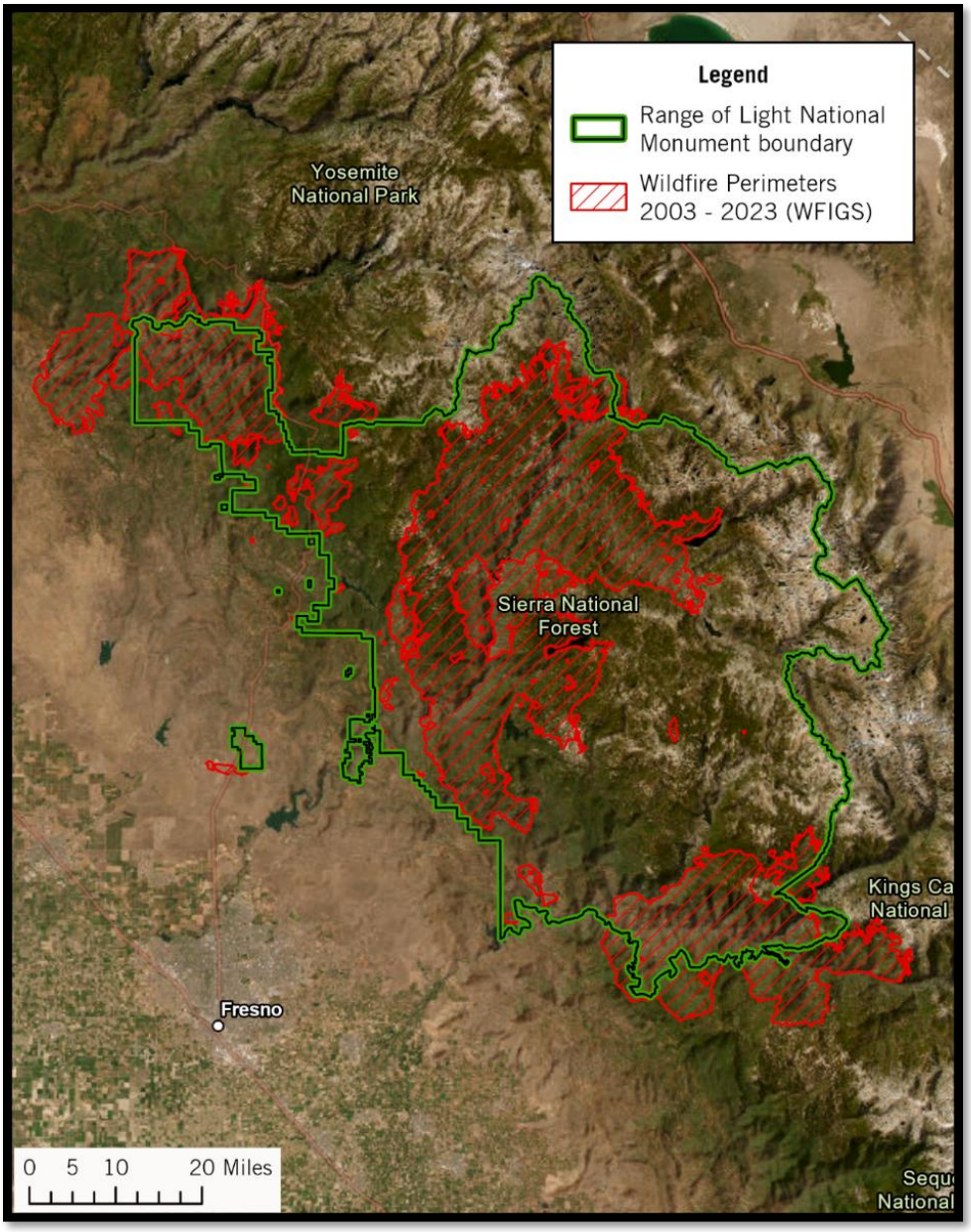

Figure 2: Sierra National Forest Fires 2013-2024*

*The Basin fire is shown in the circle; 14,023 acres burned at the time of this publication (July 2024). No fires are currently burning in the adjacent National Parks.

1.1.1 Current State of Wildfire Science

Recent studies using satellite data have found that managed forests are less fire resilient than unmanaged ones. The largest study of its kind, which comprehensively covered the western U.S., found that our least-managed forestlands – i.e., parks and wilderness areas (correcting for forest type, topography, and climate variables) are our most firesafe, and the forestlands managed the most burn with the highest frequency and severity.[3] This is occurring for several reasons, one of which is that when vegetation is removed by logging, this increases air flow and fire ventilation (i.e., the supply of fresh oxygen to a fire). Current computer fire models neglect or minimize this effect.

Forest fires require three elements: 1) ignition, 2) oxygen, and 3) fuel. Fuel garners the most attention, because current operational fire models (created to predict wildfire behavior and guide land-management decisions) focus on fuels, and use overly simplistic approximations for wind and airflow effects. This is a problem, because airflow and the supply and replenishment of fresh oxygen to a fire is more influential than fuels (6 times more influential by mass, and 2300 times more influential by volume). For example, at 4000 feet, it takes 2600 cubic feet of air to burn a small log.

When fuels are removed, airflow increases, which in certain circumstances can intensify fires and increase fire spread. Recent high-resolution numerical simulations of fire show this consequence and demonstrate its importance.[4, 5, 6] Since current operational fire models neglect this effect, they can unintentionally mislead decision-makers who may increase logging in an attempt to make forests fire safe, while actually achieving the opposite result. To address this, the missing air-flow effects must be incorporated into existing models. The Forest Service and other research scientists are working on the next-generation operational fire models that include fire-atmosphere coupling, but until then, caution should be exercised when making management decisions, particularly in relation to

[3] Bradley, C.M. C.T. Hanson, and D.A. DellaSala. 2016. Does increased forest protection correspond to higher fire severity in frequent-fire forests of the western USA? Ecosphere 7: article e01492

[4] Atchley, A.L., R. Linn, A. Jonko, C. Hoffman, J.D. Hyman, F. Pimont, C. Sieg, R.S. Middleton. 2021. Effects of fuel spatial distribution on wildland fire behavior. Int'l Journal of Wildland Fire. doi:10.1071/WF20096

[5] Coen, J.L., Schroeder, S. Conway, L. Tarnay. 2020. Computational modeling of extreme wildland fire events: a synthesis of scientific understanding with applications to forecasting, land management, and firefighter safety. Journal of Computational Science 45, 101152

[6] Banerjee, T., Heilman, W., Goodrick, S. et al. Effects of canopy midstory management and fuel moisture on wildfire behavior. Sci Rep 10, 17312 (2020). https://doi.org/10.1038/s41598-020-74338-9

logging, post-fire logging, and removing trees and plant species, which can increase the ambient windspeed by removing impediments to the wind, and thereby increase the fire-spread rate.

1.1.2 Other Factors Affecting Fire - Human-Caused Wildfires

Another often neglected and rarely discussed element of fire and wildfire behavior is the degree to which humans affect wildfires and the timing of those wildfires. A study published in 2017 found that 84% of U.S. wildfires were caused by human-related activity;[7] the remaining 16% were caused by lightning. Two decades of government agency wildfire records show the fundamental role of human ignitions; not only did humans start 8 of 10 wildfires, they tripled the length of the fire season, and affected an area seven times greater than that affected by lightning fires.[8]

In California, 95% of all wildfires are reportedly human-caused; 19,543 wildfires were attributed to people between 2000 and 2022 on Forest Service land. In addition, human-caused blazes tend to be more destructive and deadly than those caused by lightning,[9] because they often start near developed land with fewer trees and later in the season when grasses are especially combustible. California human-caused wildfires between 2012 and 2018 were on average 6.5 times larger than those caused by lightning strikes and killed three times as many trees. They are also more expensive because they threatened houses; more than half of wildfire-fighting costs go to defending homes.

Researchers concluded that "national and regional policy efforts to mitigate wildfire-related hazards would benefit from focusing on reducing the human expansion of the fire niche,[10]" and an aspect of that requires management of public access during high-fire season and when severe-weather conditions occur. In other words, when conditions warrant it, ignitions and people should be managed appropriately.

1.1.3 Forest Service Response to Wildfires

That said, despite this evidence and these conditions, the primary focus of Forest Service fire-management efforts continues to be commercial logging and thinning and increasing logging at a "landscape-scale," as shown in the Region 5 Post-Disturbance Hazardous Tree Management Project in the Sierra National Forest. This project proposes to

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[7] Balch, J.K., B.A. Bradley, J.T. Abatzoglou, R.C. Nagy, E.J. Fusco, A.L. Mahood, 2017. Human-started wildfires expand the fire niche across the United States. Proc. Nat'l Accad. Sci. 114(11) pp.2946-2951.

[8] Balch, J.K., B.A. Bradley, J.T. Abatzoglou, R.C. Nagy, E.J. Fusco, A.L. Mahood, 2017. Human-started wildfires expand the fire niche across the United States. Proc. Nat'l Accad. Sci. 114(11) pp.2946-2951.

[9] Hantson, S., Andela, N., Goulden, M.L. et al. Human-ignited fires result in more extreme fire behavior and ecosystem impacts. Nat Commun 13, 2717 (2022). https://doi.org/10.1038/s41467-022-30030-2

[10] Balch, Jennifer & Bradley, Bethany & Abatzoglou, John & Nagy, Chelsea & Fusco, Emily & Mahood, Adam. (2017). Human-started wildfires expand the fire niche across the United States. Proceedings of the National Academy of Sciences. 114. 201617394. 10.1073/pnas.1617394114.

log 600 feet across the centerline of more than 929 miles of roads, 202 miles of trails, and 51 miles of fencing in the footprint of the Creek Fire.[11]

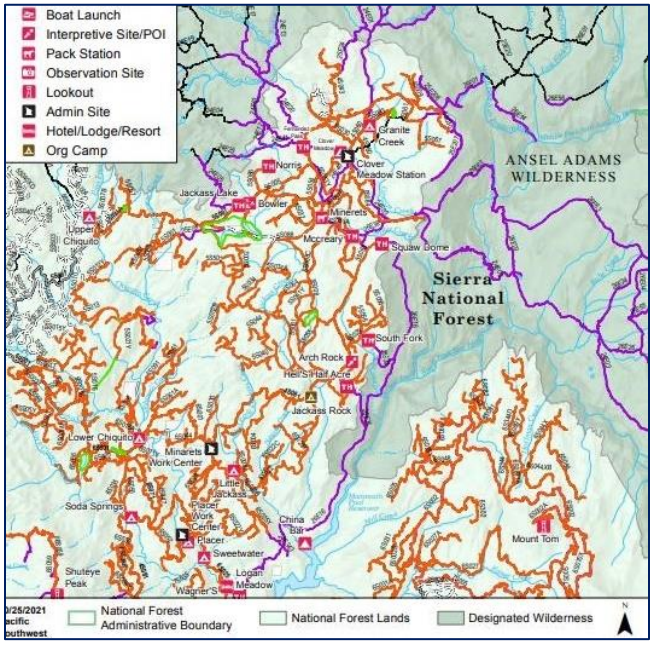

Figure 3: R5 Post-Disturbance Hazardous Tree Management Project. Red lines = Logging Areas

The language used to describe this logging is "hazard tree management, fire safety, forest resilience, restoration, and fuel reduction," which distracts from the lasting and harmful effects of these actions, and is potentially misleading as these actions may create a landscape that is less resilient to fire.

Post-fire logging is also one of the most damaging activities performed on public lands; it disrupts the recovery of the forest ecosystem, it damages soils, it removes native-plant species, which are needed to keep the soils and minerals intact in delicate post-fire conditions, and, finally, it increases the likelihood of future fires.[12]

1.1.4 Positive Effects of Controlled Burns & Cultural Burning

In addition, because of the Forest Service's focus on logging, controlled burning and managed wildfires are inhibited and mechanical treatments are favored.[13] Yet, it has been well-established in the scientific community that managed wildfires and small controlled burns with little mechanical treatments are the most effective way to manage a landscape for fire, and the most economical and environmentally sound approach. It costs $565 per acre to mechanically thin an area versus $145 per acre to manage controlled burns, specifically in the Sierra Nevada.[14] Fire can also be used to reduce fuels either intentionally (prescribed burning) or opportunistically (letting a natural ignition burn as "managed wildfire") under moderate weather conditions. Although these burns are much less precise

[11] "Region 5 Post-Disturbance Hazardous Tree Management Project." *United States Forest Service*, https://www.fs.usda.gov/project/sierra/?project=60950 Accessed 24 April 2024.

[12] Donato DC, Fontaine JB, Campbell JL, Robinson WD, Kauffman JB, Law BE. Post-wildfire logging hinders regeneration and increases fire risk. Science. 2006 Jan 20;311(5759):352. doi: 10.1126/science.1122855. Epub 2006 Jan 5. PMID: 16400111.

[13] North, Malcolm P.; Collins, Brandon M.; Stephens, Scott L. 2012. Using fire to increase the scale, benefits and future maintenance of fuels treatments. Journal of Forestry. 110(7): 492-401.

[14] North, M.P.; Brough, A.; Long, J.W.; Collins, B.M.; Bowden, P.; Yasuda, D.; Miller, J.; Suighara, N. 2015. Constraints on mechanized treatment significantly limit mechanical fuels reduction extent in the Sierra Nevada. Journal of Forestry 113: 40-48.

than mechanical thinning, in remote locations, fire is usually more efficient, cost-effective, and ecologically beneficial than mechanical treatments.[15]

Additional factors, which influence ecosystem resilience, are the expansive and detrimental pre- and post-logging activities, including snag removal and native-plant removal via the use of herbicides such a glyphosate (commercially sold as "Round Up"). Herbicide application (along with surfactants such as R-11, a spreading agent) further desiccates the landscape – while directly harming the ecosystem. Finally, the intrusion, construction, and reconstruction of thousands of miles of roads to support logging in these sensitive areas creates significant and lasting damage—immediately removing vegetation, disrupting the soils, creating erosion, and increasing the likelihood of human-caused fires.

In sum, the Forest Service's current "fire-resilience" activities may not prevent or mitigate wildfires, and they may be making them more likely to occur.

1.1.5 A Case Study: The Creek Fire Versus the KNP Complex Fire

In 2020, the Creek Fire burned in the Sierra National Forest over a heavily logged landscape in areas where two fires had previously occurred, burning more than 379,000 acres. It was the largest single fire in California history. It burned mostly in the lower-elevation expanse of the forest, incinerating previously burned acreage (the Aspen and French fires burned in the footprint of the fire). The reduction of trees due to logging and prior fires did not prevent this fire from rapidly sweeping upslope. The fire progressed at an astounding 40,000 acres per day so that in just one week it burned half of the front-county. Forecast ambient winds were 50 mph, but fire-induced winds reached as high as 125 mph. See Fire Progression Maps on the following pages.

Figure 4: Creek Fire aftermath. View from Mile High Vista

[15] North, M.P., S.L. Stephens, B.M. Collins, J.K. Agee, G. Aplet, J.F. Franklin, and P.Z. Fule. 2015. Reform forest fire management. Science 349: 1280-1281

1.1.6 Fire Progression Map – Creek Fire

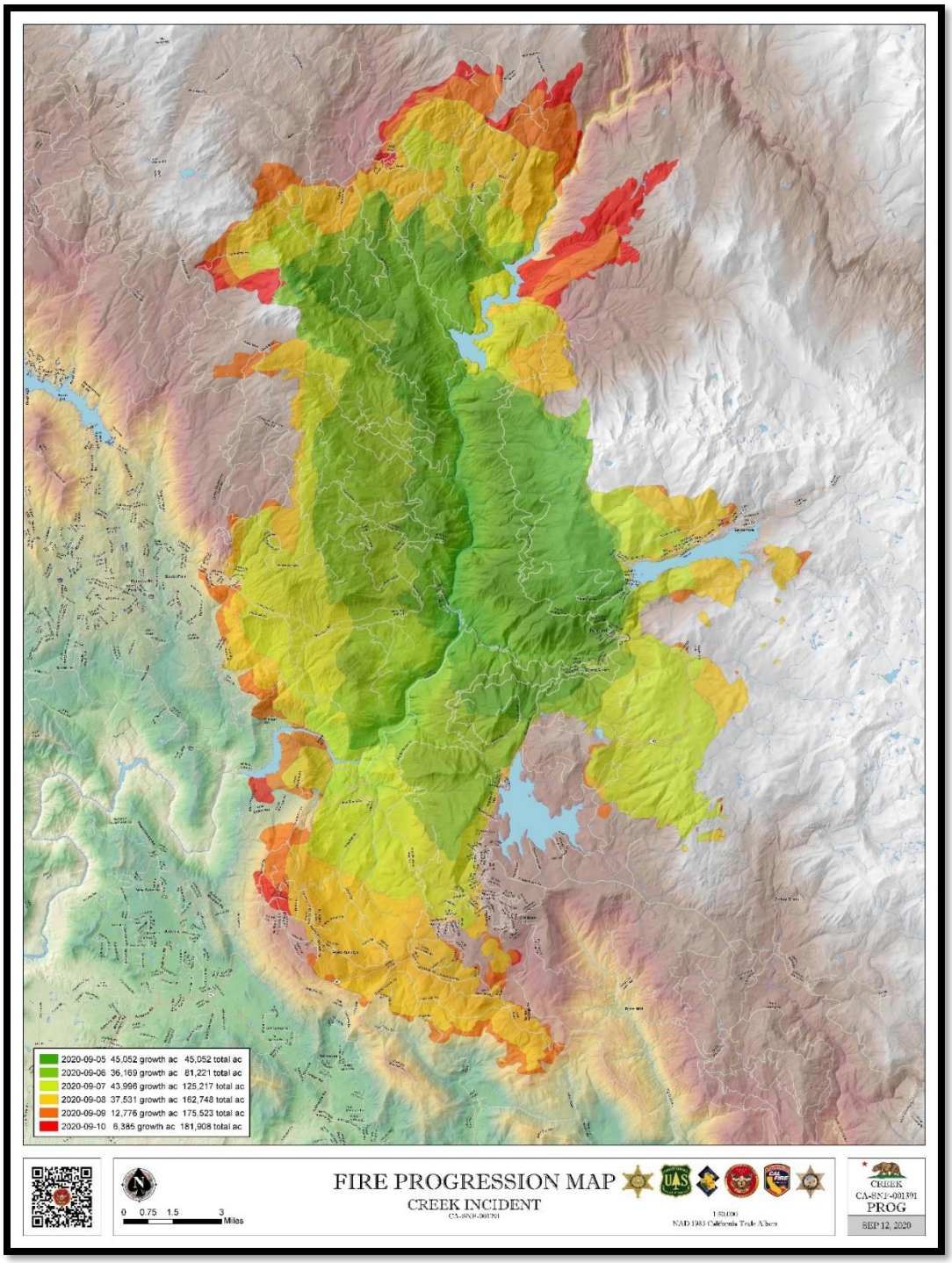

Figure 5: Fire Progression Creek – Sierra National Forest –Sept 4 2020 – approximately 379,000 acres – average progression 40,000 acres a day

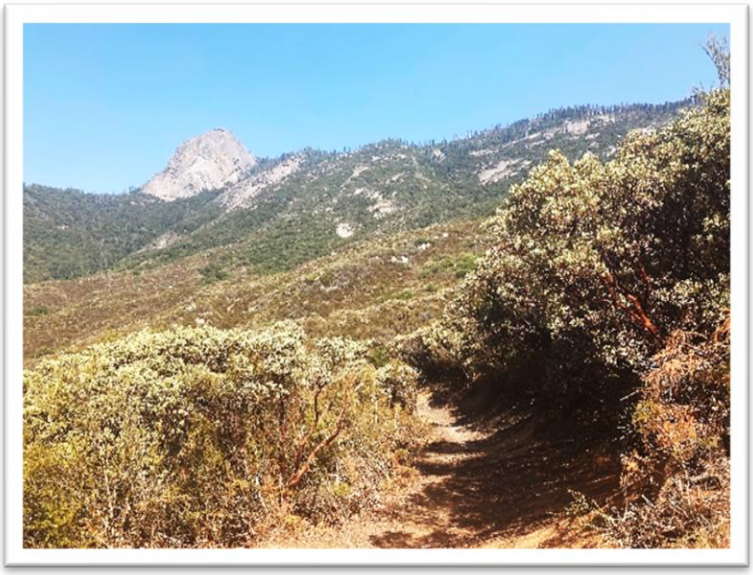

Figure 6: Kaweah River Valley 2021 – One month prior to the KNP Complex Fire

Figure 7: Kaweah River Valley Post KNP Fire May 2022

In contrast, the KNP Complex Fire, which burned a year later in Sequoia National Park, burned evenly and slowly across a heavily wooded and protected terrain – primarily wilderness. It burned about 4000 acres per day, an order of magnitude less, reaching only 88,000 acres, under similar weather conditions, at the same time of year, and after an additional year of drought. The burn area (the Kaweah River Basin) is heavily laden with brush and trees (aka fuels), and yet, the fire did not explode upslope. Forecast winds were 40 mph, comparable to the Creek Fire ambient winds of 50 mph.

Restricted airflow in the Kaweah River Basin may have contributed to the lower fire-spread rate in two important ways: 1) reducing oxygen supply to the fire and 2) having a higher vegetation moisture content. The post fire conditions of the KNP Complex Fire are also vastly different from those of the Creek Fire. Patchy burned areas are interlaced with trees and shrubs, creating open patches in the landscape but few barren areas.

1.1.7 Fire Progression Map – KNP Complex Fire

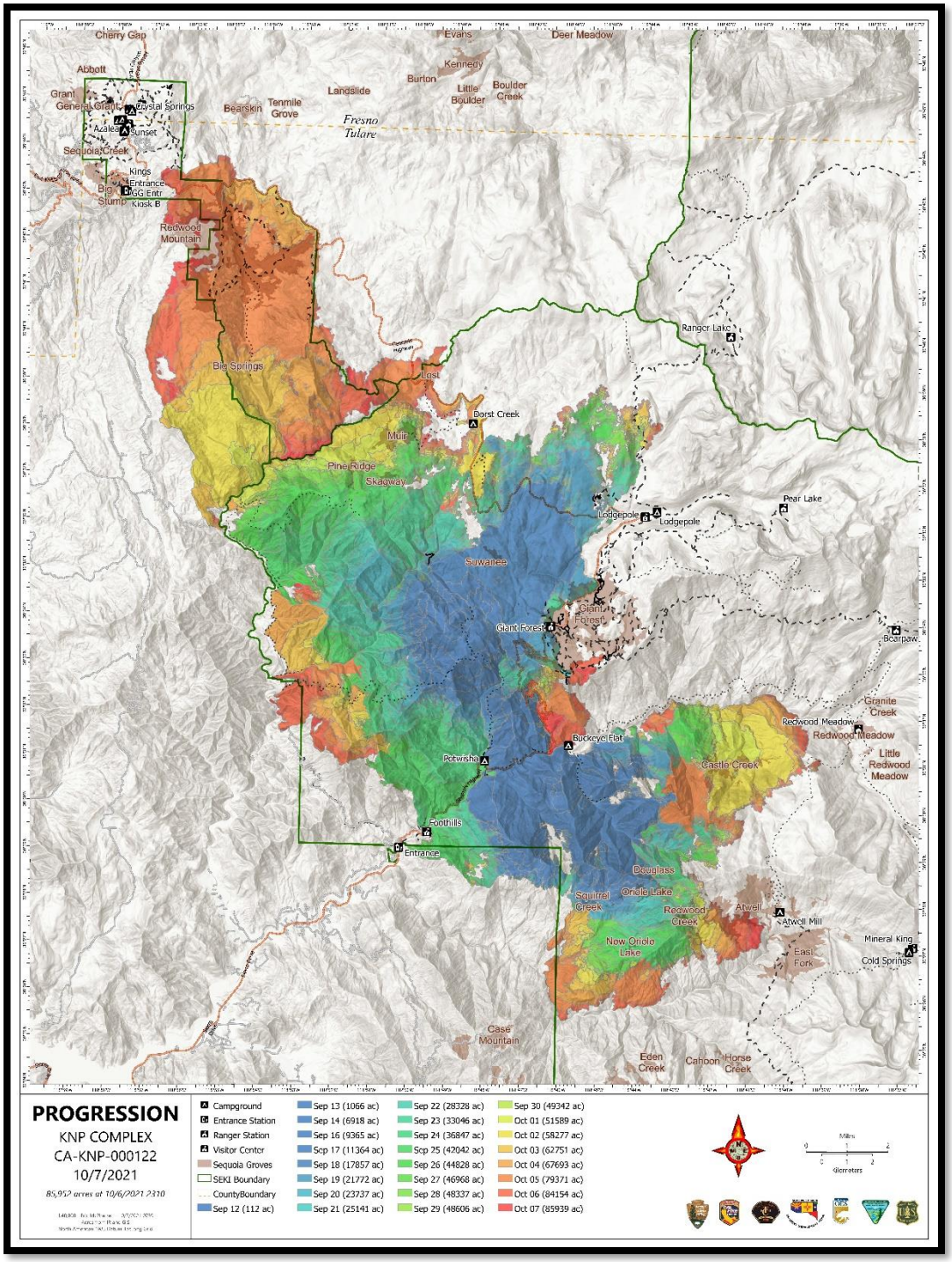

Figure 8: Fire Progression KNP Complex – Sequoia National Park – Sept 9 2021 – approximately 88,000 acres, average progression 4,000 acres a day.

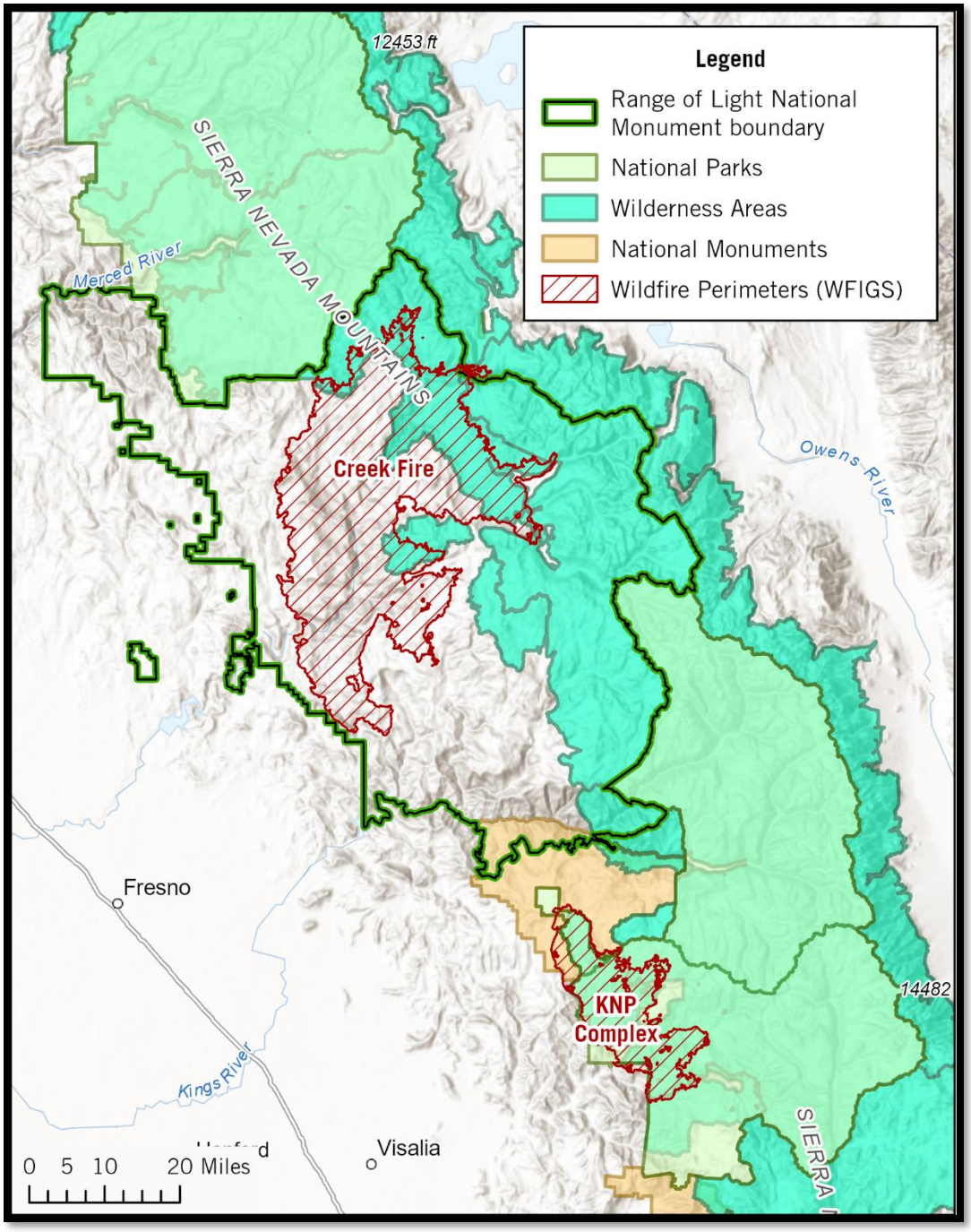

Figure 9: Creek Fire (2020) and KNP Complex Fire (2021)