USDA Forest Service
U.S. DEPARTMENT OF AGRICULTURE

Land Management Plan Monitoring Report for the Angeles National Forest (2019 – 2020)

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I am pleased to present the Angeles National Forest's Monitoring and Evaluation Report for your review. The purpose of the Monitoring and Evaluation Report is to share our determination of the effectiveness of the Land Management Plan and whether changes are necessary to the Plan, or in program or project implementation.

The lessons we learn from monitoring help improve our programs and projects. We continue to seek ways to increase efficiency and effectiveness of our monitoring and evaluation efforts. It is my commitment to keep you informed of the monitoring results by providing this report. If you would like to participate in future monitoring, please contact the Forest.

We have evaluated the monitoring results presented in this report and we do not recommend changes to the monitoring program or the plan components contained within the 2006 Land Management Plan and management activities.

Your continued interest in the Angeles National Forest Land Management Plan is just one way for you to stay current with activities on your public lands. Additional information can be found on our website at www.fs.usda.gov/angeles.

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Forest Supervisor

Angeles National Forest

About our Plan Monitoring Program

Purpose

The purpose of this monitoring report is to describe the evaluation of information gathered through Part 1 (effectiveness) monitoring of the Southern California land management plan monitoring program.

The Angeles, Cleveland, and San Bernardino National Forests share the same plan monitoring program, which is divided into three parts, under the Southern California land management plan (2006). This report includes the results for the first nine questions of Part 1 monitoring for the Angeles National Forest during fiscal years 2019-2020. This report also includes the results for the Cleveland (2020) and San Bernardino (2019-2020) National Forests.

The Angeles National Forest was unable to answer every monitoring question associated with Parts 1-3. The Forest has experienced high staff turnover and substantial staffing constraints. The restrictions imposed by the pandemic (e.g., stay-at-home mandates, lack of field data collection, shifting priorities) further restricted monitoring opportunities and those restrictions continued through 2022.

The Angeles is proposing to amend the monitoring plan by narrowing the scope of the biennial reporting to include only the questions that make up Part 1, which fulfills the monitoring requirements of the 2012 Planning Rule (36 CFR 219.12(a)(5), FSH 1909.12) through a series of 20 questions. The proposed change would eliminate Parts 2 & 3 from the LMP monitoring program and take effect beginning with the 2019-2020 biennial report, while eliminating Parts 2 & 3 from all future monitoring reports.

This report is not a decision document. Rather, this report has been developed in compliance with the National Forest Management Act policy 36 CFR 219.12. This report is a vehicle for disseminating to the public timely, accurate monitoring information as well as recommended changes and adaptive management responses.

How Our Plan Monitoring Program Works

Forest plans are required to have plan monitoring programs that inform the management of resources in the plan area by testing relevant assumptions, tracking relevant changes, and measuring management effectiveness and progress towards achieving plan components like desired conditions and objectives (36 CFR 219.12). The monitoring results help the Forest Supervisor determine whether a change is needed in forest plan direction, such as plan components or other plan

content that guide management of resources in the plan area, management activities, the monitoring program, or whether a new assessment is warranted.

Collectively, the Part 1 monitoring questions cover the eight required topics under the 2012 planning rule, in addition to social, economic, and cultural sustainability (see box below). Some questions cover more than one topic. The monitoring questions are grouped by the seven goals in the land management plans: (1) community protection and restoration of forest health; (2) invasive species; (3) managed recreation in a natural setting and Wilderness; (4) energy and minerals production; (5) watershed function and riparian condition; (6) rangeland and biological resource condition; and (7) natural areas in an urban context. The monitoring questions, indicators, and results you'll read about in this report address these goals. The plan monitoring program and a separate monitoring guide that describes the details of how the plan monitoring program is implemented, including data sources and analyses, are available upon request.

The Southern California Land Management Plan monitoring program covers these eight required topics, in addition to social, economic, and cultural sustainability:

1. The status of select watershed conditions.
2. The status of select ecological conditions including key characteristics of terrestrial and aquatic ecosystems.
3. The status of focal species to assess the ecological conditions required under § 219.9.
4. The status of a select set of the ecological conditions required under § 219.9 to contribute to the recovery of federally listed threatened and endangered species, conserve proposed and candidate species, and maintain a viable population of each species of conservation concern.
5. The status of visitor use, visitor satisfaction, and progress toward meeting recreation objectives.
6. Measurable changes on the plan area related to climate change and other stressors that may be affecting the plan area.
7. Progress toward meeting the desired conditions and objectives in the plan, including for providing multiple use opportunities.
8. The effects of each management system to determine that they do not substantially and permanently impair the productivity of the land (16 U.S.C. 1604(g)(3)(C)). (36 CFR 219.12(a).

Opportunity for Public Engagement and Partnerships

We welcome your questions, suggestions, and feedback. We also welcome opportunities for partnerships to implement this plan monitoring program. Please reach out to the environmental coordinators on the relevant Forests to share your ideas and feedback. This monitoring report describes the key results from our monitoring; in depth results, including additional graphics and tables, are described in a supplemental report and is available upon request.

What Comes Next

The next reporting cycle for Part 1 of the Forests plan monitoring program would cover monitoring activities conducted during fiscal years 2021 and 2022. Some data to support this monitoring (e.g., fire perimeters, fire return interval departure) will be available in the summer of 2023. We anticipate releasing our next report in 2024.

Monitoring reports should include relevant information from the regional broader-scale monitoring strategy. The Pacific Southwest Region broader-scale monitoring strategy (version 1) was published in June 2020. Results from this strategy, when they are available, will be made available to the Forest for incorporation in future biennial monitoring evaluation reports.

Results Summary

This monitoring report describes the results of monitoring activities that occurred during fiscal years 2019 and 2020 for the Angeles and San Bernardino National Forests, and monitoring activities that occurred in fiscal year 2020 for the Cleveland National Forest. Current data were not available for some monitoring questions like tree mortality (MQ7 & 8) and shrub conversion to grasslands (MQ9). For these questions, we used data that were available through the most recent year.

Monitoring results indicate that, in general, all three forests are making progress at achieving the goals set forth in the 2006 Land Management Plan (Table 1). Based on the monitoring trends, we believe the plan components and management activities continue to be effective in trending the landscape towards achieving the goals and desired conditions described in our land management plan. We do not see the need for changes or for a new assessment. However, all three Forests are facing extended drought conditions, climate change, threats from newly introduced invasive pests such as the Goldspotted oak borer. These challenges coupled with landscapes that continue to remain departed from historic fire frequency in many cases make the urgency of forest management and fuels reduction even more pressing.

Table 1. Summary of key findings for the Southern California land management plan monitoring and recommendations for action, adaptive management, or change. Monitoring results for the Angeles and San Bernardino cover fiscal years (FY) 2019 and 2020 and results for the Cleveland cover FY 2020.

Monitoring Questions	Summary of Key Findings	Recommended action, adaptive management, or change
MQ1. Has the forest made progress in reducing the number of acres that are adjacent to development within Wildland Urban Interface (WUI) defense zones that are classified as high-risk?	The Angeles, Cleveland, and San Bernardino conducted 136, 1131, and 2750 acres of treatments in the WUI defense zone, respectively.	All three forests have made progress in reducing the baseline number of acres in the WUI defense zone classified as high risk. However, treatment must continue in order to prevent recurrence of high-risk classification

Monitoring Questions	Summary of Key Findings	Recommended action, adaptive management, or change
		within previously treated WUI defense zone. Recommendation is to continue to treat high risk zones within the WUI defense while monitoring previously treated areas to ensure they are being treated prior to re-entering a high-risk classification.
MQ2. Are wildfires becoming larger, more frequent, or more severe, and is there a seasonal shift in fire activity?	Wildfire size has fluctuated over the last century/half century. The proportion of wildfires burning at high severity has been increasing. Fires have burned in every month.	Continue fuels treatment within montane forest ecosystems to return the fire frequency to the natural range of variation which will in turn reduce the likelihood of severe fire behavior. In chaparral ecosystems, continue to focus on the management and maintenance of fuel breaks, particularly in the WUI defense zone to protect vulnerable communities and reduce fire frequency.
MQ3. Are fire frequencies becoming more departed from the natural range of variation?	Although each Forest's landscape is trending towards the natural range of variation for fire frequencies (condition class 1 has *increased* since 2006), a large proportion of each Forest is moderately and highly departed from historic fire frequencies.	Continue fuels treatment to move more of the landscape into condition class 1, particularly within montane forest landscapes (Fire Regime I) where frequent low severity burns thin stands, keep fuel loading low and

Monitoring Questions	Summary of Key Findings	Recommended action, adaptive management, or change
		encourage the regeneration of shade-intolerant plant species.
MQ4. Is the forest making progress toward increasing the percentage of montane conifer forests in Condition Class 1?	Although each Forest's montane conifer zone (Fire Regime I) is trending towards the natural range of variation for fire frequencies (condition class 1 has *increased* since 2006), the largest proportion of this zone on each Forest is highly departed from historic fire regimes, burning far less frequently than historically. The Forests continue to emphasize treatments in areas moderately and highly departed to improve resilience.	Continue fuels treatment to move more of the montane conifer forest into condition class 1. Complete NEPA documentation for additional montane forest ecosystems to allow additional fuels treatment beyond what has been analyzed currently in existing NEPA documents.
MQ5. Is the forest making progress toward maintaining or increasing the percentage of vegetation types that naturally occur in Fire Regime IV in Condition Class 1?	Although the proportion of Fire Regime IV (shrubland and chaparral) in condition class 1 *increased* since 2006, a large proportion of these landscapes on each of these Forests are still burning more frequently when compared to historic conditions.	Explore opportunities to reduce anthropogenic fire starts in high-risk areas such as roadsides and fuel breaks to ecosystems in Fire Regime IV to reduce burn frequency and return to Condition Class I.
MQ6. Has the forest been successful at maintaining long fire-free intervals in habitats where fire is naturally uncommon?	The Angeles and San Bernardino experienced a decrease in the acres (and proportion of the landscape) that are within (or slightly departed) from the historic fire regime. The majority of the Fire Regime V landscape on these Forests is highly	Continue and expand fuels treatments in and adjacent to habitat where fire is naturally uncommon, in order to reverse current trends and decrease likelihood of fires starting in or spreading through these

Monitoring Questions	Summary of Key Findings	Recommended action, adaptive management, or change
	departed from the historic fire regime, burning with far more frequency than historically.	areas.
MQ7. Is tree mortality increasing across the landscape, and is it distributed evenly across elevations?	All Forests experienced a peak in mortality between 2015 and 2017, coinciding with a drought period. The dominant conifer species affected include white fir and yellow pine (Jeffrey and ponderosa pines). The lower and higher elevations (rather than middle) experienced greater change in mortality from 2006.	Continue and expand fuels treatments within montane conifer forests (Fire Regime I). By treating montane forest to decrease stand density and increase forest health, forests will be more resilient and less susceptible to mortality from drought and disease.
MQ8 (CNF only). Is coast live oak mortality increasing across the landscape?	The number of dead oak trees increased substantially during the most severe drought years (2015-2017). The number of dead oak trees remained elevated in 2018 but was much lower in 2019. The greatest concentration of annual dead oak trees tends to be on the leading edge of an area infested with goldspotted oak borer.	Continue to actively manage infestations on the Trabuco Ranger District, utilizing an early-detection rapid-response (EDRR) approach. Strategy may include proactive surveys, removal of infested trees and treatment of trees with targeted insecticides. Additionally, educating the public of the role firewood can play in facilitating infestations is crucial.
MQ9. Are chaparral and coastal sage scrub vegetation communities type converting to non-	There has been an increase in the acres and percent of the shrubland landscape that has type converted to non-native annual grasslands between 2009	Combat type conversion by focusing on returning chaparral and coastal sage scrub communities (Fire Regime IV) to

Monitoring Questions	Summary of Key Findings	Recommended action, adaptive management, or change
native annual grasslands?	and 2018. However, the proportion of non-native annual grasslands measured is low (1%) and San Bernardino saw a decrease between 2017 and 2018.	Condition Class I by reducing the risk of anthropogenic fire starts and containing fires to prevent type conversion within communities that are currently burning at higher frequencies than the natural range of variation.

Part 1a Monitoring: Questions 1-9

Community Protection and Restoration of Forest Health

The first goal of the Southern California National Forests Land Management Plan emphasizes the need to improve resilience of our communities and ecosystems to wildfire. Goal 1.1 highlights community protection and the ability of southern California communities to recover from wildfire and limit the loss of life and property from wildfire. Goal 1.2 focuses on the need to restore forest health where alteration of the natural fire regime has put human and natural resource values at risk.

Wildland fire is a natural ecological process. However, many communities and ecosystems in southern California are experiencing uncharacteristic fire regimes. Many communities are built in remote areas leading to a relatively large amount of Wildland Urban Interface (WUI) that needs protection from wildfire. The desired condition is to have vegetation treated to enhance community protection and reduce the risk of loss of human life, structures, improvements, and natural resources from wildland fire and subsequent floods. Additionally, firefighters should have improved opportunities for tactical operations and safety near structures, improvements, and high resource values.

The present condition of the vegetation on the four southern California national forests has been influenced by a century of fire management (mostly fire suppression), as well as by other land-use practices such as logging, grazing and mining. The structure, function, and species composition of nearly all southern California plant communities is under the direct control of recurrent fire. The long-term goal of vegetation management is to perpetuate plant communities by maintaining or re-introducing fire regimes appropriate to each type while at the same time protecting human communities from destructive wildland fires.

Monitoring Questions

MQ1. Has the forest made progress in reducing the number of acres that are adjacent to development within Wildland Urban Interface (WUI) defense zones that are classified as high risk? The indicator associated with this question includes acres of high hazard and high risk in the WUI defense zone.

MQ2. Are wildfires becoming larger, more frequent, or more severe, and is there a

seasonal shift in fire activity? The indicators associated with this question include total and mean fire size, ignition density, fire severity, and monthly area burned.

MQ3. Are fire frequencies becoming more departed from the natural range of variation? The indicator associated with this question includes the proportion of landscape in departed fire frequency.

MQ4. Is the forest making progress toward increasing the percentage of montane conifer forests in Condition Class 1? Indicators for this question include (1) departure from desired fire regime and (2) acres by Fire Regime I.

MQ5. Is the forest making progress toward maintaining or increasing the percentage of vegetation types that naturally occur in Fire Regime IV in Condition Class 1? Indicators for this question include (1) departure from desired fire regime and (2) acres by Fire Regime IV.

MQ6. Has the forest been successful at maintaining long fire-free intervals in habitats where fire is naturally uncommon? The indicators for this question include (1) departure from desired fire regime and (2) acres by Fire Regime V.

MQ7. Is tree mortality increasing across the landscape, and is it distributed evenly across elevations? The indicators associated with this question include mortality risk assessment and Forest Health Protection Mortality Surveys.

MQ8 (CNF only). Is coast live oak mortality increasing across the landscape? (Cleveland National Forest only) The indicator for this question includes Forest Health Protection Mortality Surveys.

MQ9. Are chaparral and coastal sage scrub vegetation communities type converting to non-native annual grasslands? The indicator for this question includes extent of non-native annual grasses.

Key Results

Progress in the Wildland Urban Interface (WUI)

The Forests continue to prioritize fuel reduction treatments within the WUI defense and threat zones, including areas that have not experienced wildfire within the natural return interval and may have high fuel densities. More work is needed to bring the landscape, including the WUI defense zone, to within the Natural Range of Variation (NRV) and improve resilience.

All three Forests conducted fuel reduction treatments within and outside of the WUI during the monitoring period despite the constraints imposed by the global pandemic, widespread regional closures during two prolonged wildfire seasons, and a regional pause on prescribed burning (Table 2). About one third of the treatments were conducted in the WUI defense zone and two thirds (or more for the Angeles) were

conducted in the WUI threat zone. The different types of treatment activities are described in the supplemental report.

The Forests continue to emphasize treatments within and adjacent to areas that are outside the natural fire return interval (red color in Figure 1, Figure 2, Figure 3), especially in the montane conifer zone (Fire Regime I, brown color). These treatments help reduce unnaturally high fuel densities and improve resilience. Montane conifer ecosystems are typically characterized by frequent, low intensity wildfire. Without regular fire, stands may become overly dense with high fuel loading in forest understories.

Table 2. Fuel reduction treatment acres in the WUI defense and threat zones and Environment zone of the Angeles, Cleveland, and San Bernardino National Forests during fiscal years (FY) 2019 and 2020.

Strategic fire management zone	Angeles (FY19-20) Treatment Acres[1]	Cleveland (FY 20) Treatment Acres[1]	San Bernardino (FY 19-20) Treatment Acres[1]
WUI defense	136	1131	2750
WUI threat	8416	3073	8193
Environment	353	22	219
Total Treatment Acres	**8905**	**4226**	**11,162**

[1] Some treatments may have overlapped the same project footprint (acreage). Therefore, acres may be greater than those unique acres (footprint acres) treated on the ground. Figures 1 – 3 show the footprints of fuel reduction treatments between 2015 and 2020 for one district on each of the three Forests. Figures for the other districts, and details of the treatment activities, are available in the supplemental report.

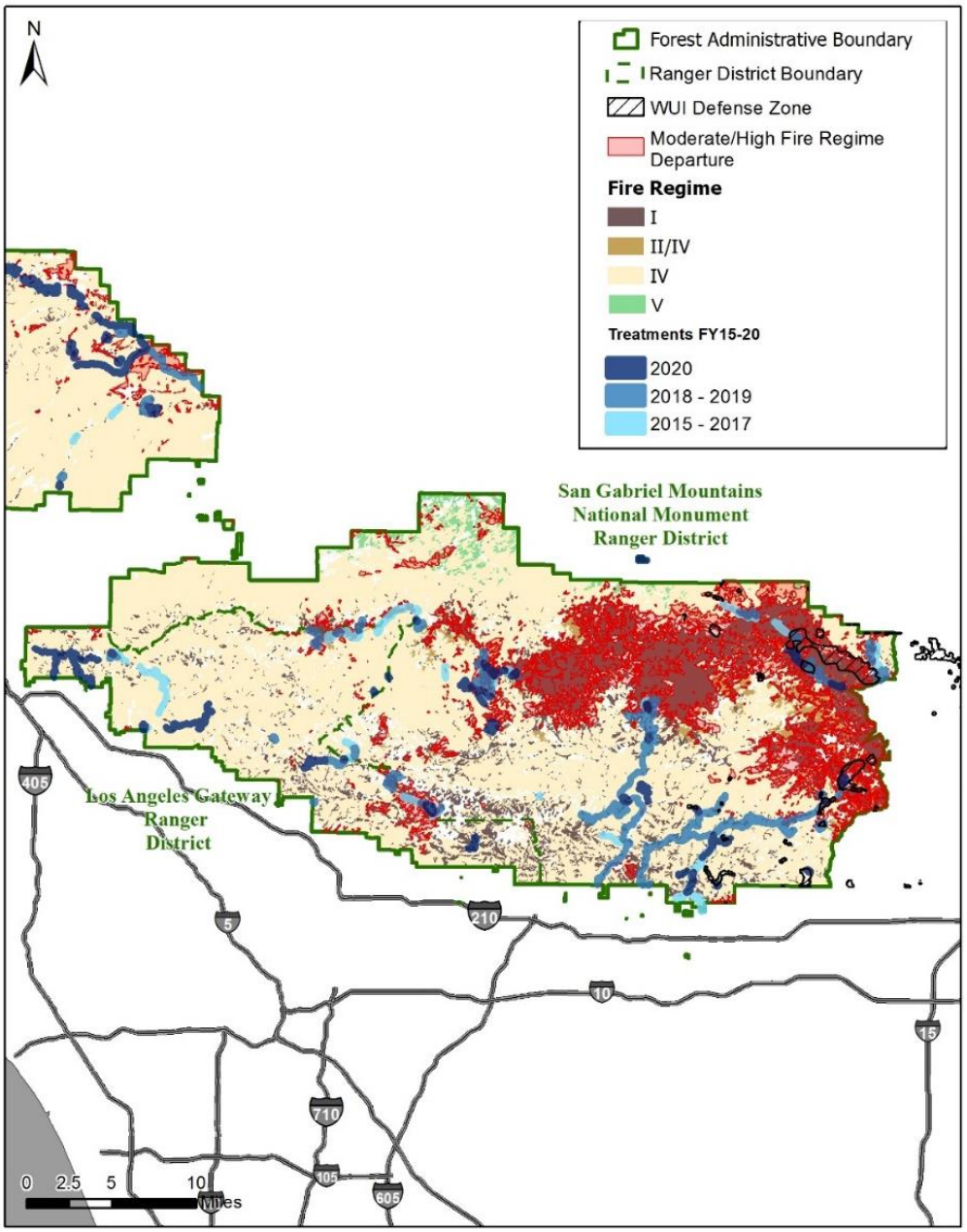

Figure 1. Fuel reduction treatments in the San Gabriel Mountain NM Ranger District on the Angeles National Forest between 2015 and 2020. Red colored areas are moderately and highly departed from the historic fire intervals, burning far less frequently than they would historically. Fire Regime I: burn interval 0-35 years and low severity (typically montane conifer); Fire Regime II/IV and IV: burn interval 35-100+ years and high severity (typically chaparral, coastal sage scrub, serpentine, gabbro, closed cone conifer, lower montane forests); Fire Regime V: burn interval 200+ years

and high severity (typically alpine/subalpine, desert woodland, forest, scrub, bigcone Douglas fir).

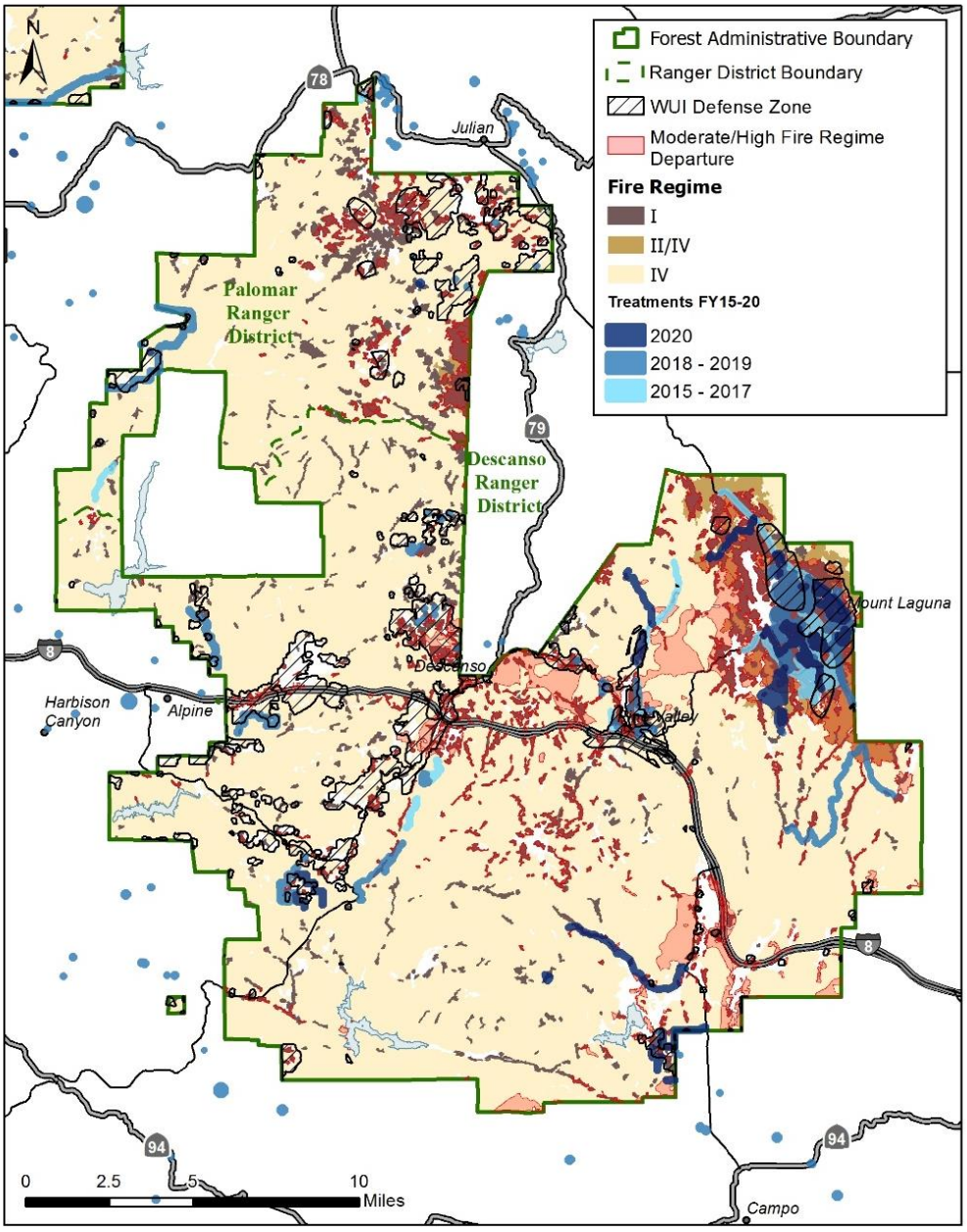

Figure 2. Fuel reduction treatments in the Descanso and Palomar Ranger Districts on the Cleveland National Forest between 2015 and 2020. Red colored areas are moderately and highly departed from the historic fire intervals, burning far less

frequently than they would historically. Fire Regime I: burn interval 0-35 years and low severity (typically montane conifer); Fire Regime II/IV and IV: burn interval 35-100+ years and high severity (typically chaparral, coastal sage scrub, serpentine, gabbro, closed cone conifer, lower montane forests).

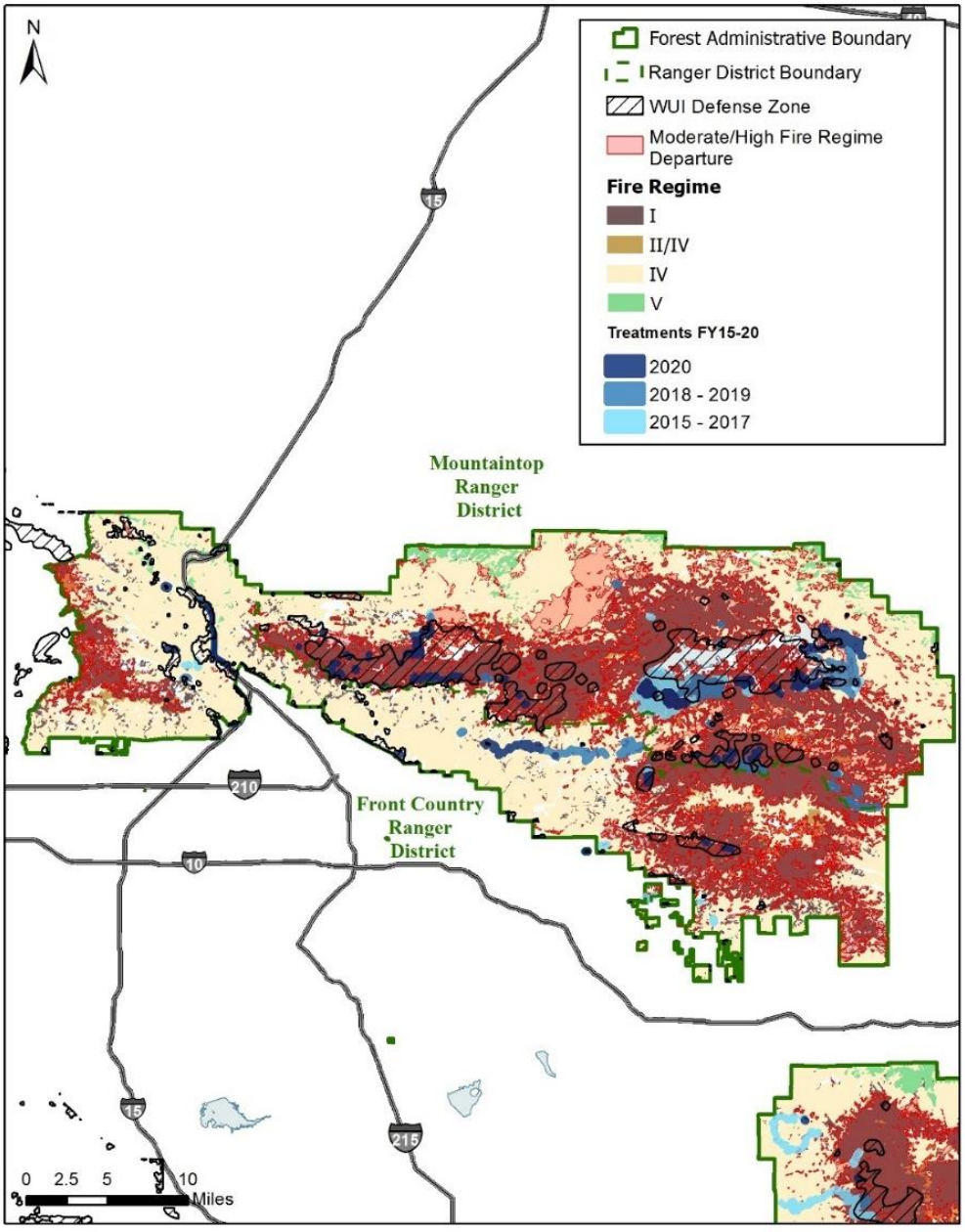

Figure 3. Fuel reduction treatments in the Front Country and Mountaintop Ranger Districts on the San Bernardino National Forest between 2015 and 2020. Red colored

areas are moderately and highly departed from the historic fire intervals, burning far less frequently than they would historically. Fire Regime I: burn interval 0-35 years and low severity (typically montane conifer); Fire Regime II/IV and IV: burn interval 35-100+ years and high severity (typically chaparral, coastal sage scrub, serpentine, gabbro, closed cone conifer, lower montane forests); Fire Regime V: burn interval 200+ years and high severity (typically alpine/subalpine, desert woodland, forest, scrub, bigcone Douglas fir).

Wildfire and fire regime changes

Fire is a natural process in these landscapes. However, the conditions on the ground and the trends in fire activity together pose risks to ecological function and natural recovery. The monitoring results suggest that wildfire size is fluctuating, severity is increasing, and fires can occur in any month of the year. The Forests are making progress in moving these landscapes towards the natural range of variation (NRV), but a large proportion of each Forest continues to be in a moderately and/or a highly departed state, especially in the montane conifer zone where fires are burning much less frequently than historic fire return intervals. The Southern California LMP provides direction to protect natural resources, including by building in resilience to the landscape and decreasing the gap between current conditions and NRV, particularly for wildfire. These results suggest that decades of fire suppression and climate change continue to challenge the Forest efforts to restore resilience and work is needed, especially in the montane conifer zone, to move ecosystems toward NRV at a more rapid pace. These management actions would encourage resilience to future fire and prime these ecosystems for adapting to changes in the fire regime driven by past management and climate change.

For all the Forests, collectively, wildfire size has fluctuated since 1900 with an uptick in acres burned in the last 20 years (Figure 4). The acres of montane forest burning at high and very high severity (stand replacing) has dramatically increased over the past 40 years (Figure 5). Most recently the trend in high severity fires burning in forested areas was highlighted by the Apple and El Dorado fires (2020) on the San Bernardino NF. Since the 1970s, the start of our evaluation, fires have burned in nearly every month of the year (Figure 6). There is not a major, discernable trend in the wildfire season except that the season started to become more active in May beginning in the 1990s. Before the 1990s, the wildfire season appeared to show increased activity beginning in June.

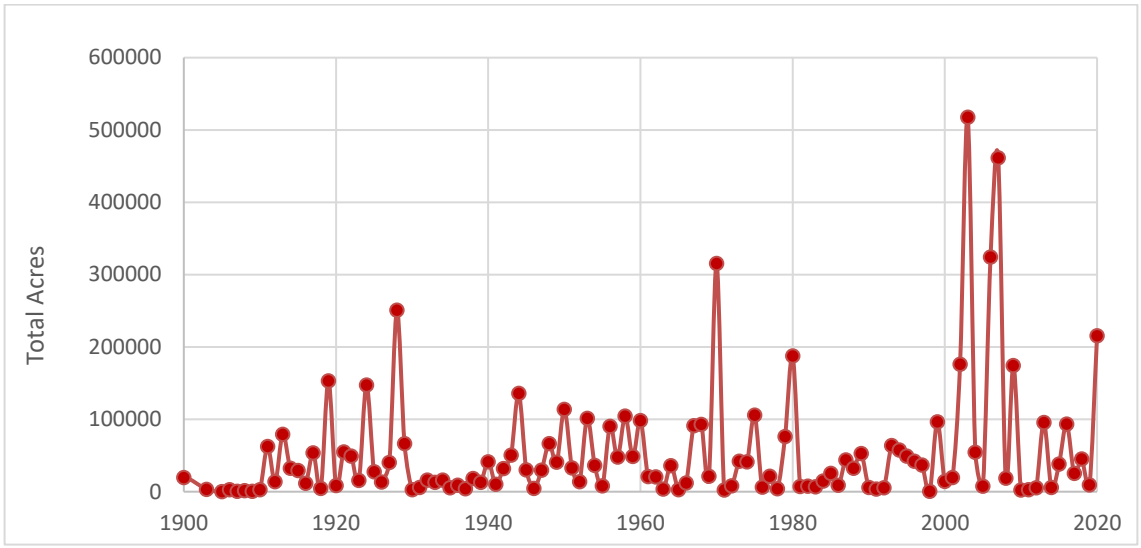

Figure 4. Trend in total wildfire size on the Angeles, Cleveland, and San Bernardino National Forests since 1900.

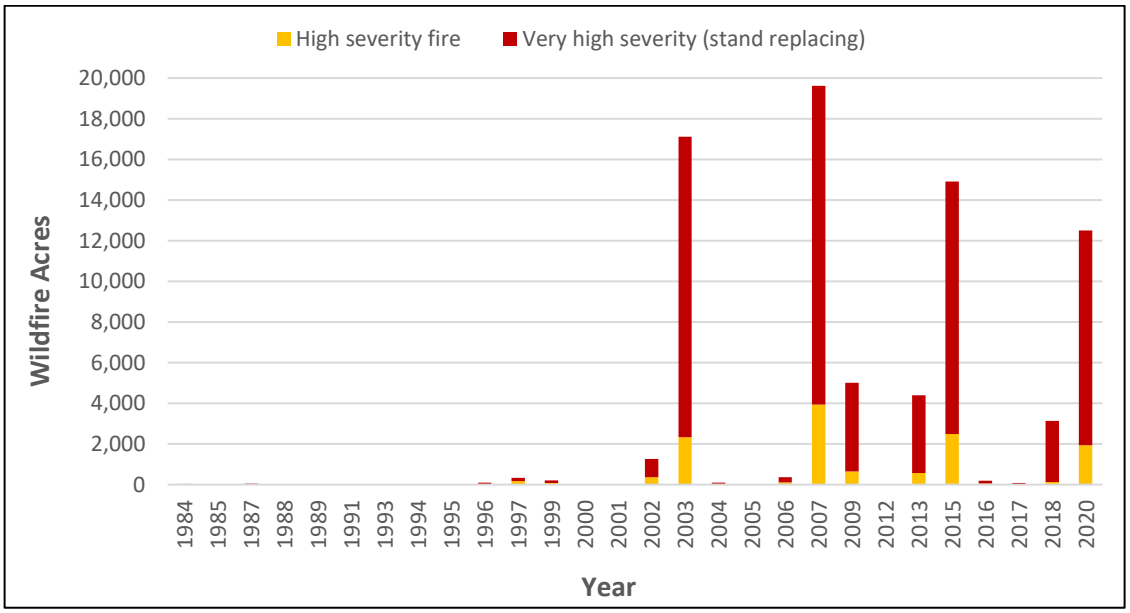

Figure 5. Acres of wildfires burning at high severity and very high severity on the Angeles, Cleveland, and San Bernardino National Forests between 1984 and 2020. High severity is measured as a loss of more than 75% tree basal area and very high severity is measured as a loss of more than 90% tree basal area. Basal area represents the

density of trees in an affected stand.

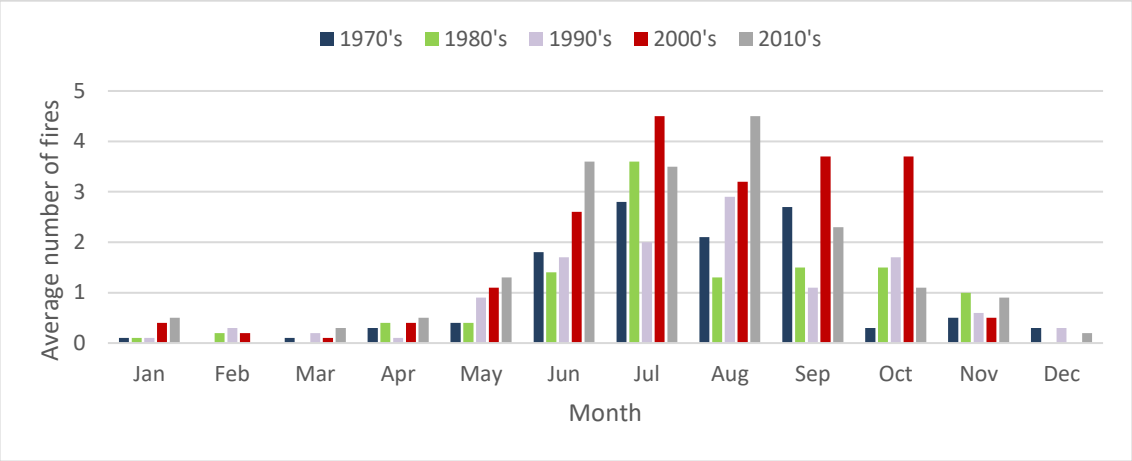

Figure 6. Average number of wildfires each month on the Angeles, Cleveland and San Bernardino National Forests from 1970-2020.

We examined the extent of fire departure from the natural return interval to get a sense of whether the landscapes, and their representative ecosystems, are experiencing more frequent or less frequent fires than historically. Overall, there have been some positive trends on each of the Forests. Between 2006 and 2020, the Angeles National Forest has seen an increase in the proportion of the Forest experiencing fire cycles within or only slightly departed from the natural fire return interval and a decrease in the proportion of the Forest that is moderately and highly departed from the natural fire return interval (Figure 7). Overall, the Cleveland and San Bernardino trends are similar to the Angeles except the Cleveland has seen a very slight (1%) increase in the proportion of the Forest that is highly departed from the natural fire return interval, burning far more frequently than historically, and the San Bernardino has experienced a slight decrease (1%) in the proportion of the landscape within the natural return interval (Figure 7).

Despite the positive trends, a large proportion of each Forest continues to be moderately and/or highly departed from the historic fire return intervals (Figure 7). Figure 8, Figure 9, and Figure 10 illustrate the locations on each Forest where fire return interval is within or departed from the historic cycle. This finding is especially true for the San Bernardino National Forest where a large proportion is burning far less frequently than the natural return interval (Figure 7). There is a need to continue (and increase the pace and scale of) management intervention, including prescribed fire and wildfire management for resource benefit, in these areas that are burning less frequently than historically. Such management can reduce fuel loadings, restore structure, and improve resilience. In areas burning far more frequently, there is an

opportunity to evaluate ecosystem condition after fire to determine recovery actions and priorities. The Forest Service recently released the *Postfire Restoration Framework for National Forests in California* (Meyer et al. 2021) that is currently being applied to the Bobcat fire on the Angeles National Forest. Moving forward, the Forests may identify guidelines that trigger when a post-fire restoration evaluation is needed.

Montane Forest (Fire Regime I)

Although there was a positive trend between 2006 and 2020 in the acres of montane conifer that are experiencing fire intervals within or slightly departed from the historic fire frequency, the data overwhelmingly indicate that the montane conifer zones of these Forests are burning far less frequently than historically. Approximately 64%, 64%, and 91% of the montane conifer forests on the Angeles, Cleveland, and San Bernardino National Forests, respectively, are *burning less frequently* when compared to historic fire frequencies. Forests departed from the natural range of variation for fire typically have altered forest structure and composition (e.g., unnaturally dense conditions).

All Forests prioritized treatments in those areas highly departed (burning much less frequently) from the historic fire return intervals (Table 3). Treatments were focused in areas that are highly and moderately departed from the historic fire regime, burning less frequently than historically. Please note that treatment acres (e.g., mechanical thinning, broadcast burning) may be different from footprint acres (unique acres treated on the ground) because some acres may have received more than one treatment activity.

Table 3. Treatment acres in areas burning less frequently than historically in the montane conifer (Fire Regime I) zone.

National Forest	High departure (acres)	Moderate departure (acres)	Within or low departure (acres)
Angeles (FY19-20)	1201	489	318
Cleveland (FY20)	2083	119	31
San Bernardino (FY19-20)	5406	188	36

Shrubland and Chaparral (Fire Regime IV)

For each Forest, we observed an increase in the proportion of the Forest shrubland and chaparral zones that are within or low departure (≤ 33%) from historic fire frequencies. Indeed, as of 2020, most of this fire regime is now within (or only minimally departed from) the historic fire regime. However, a large proportion of the shrub and chaparral-dominated landscapes on each of these Forests are still burning

more frequently when compared to historic conditions.

Scrub (Fire Regime V)

For Fire Regime V, dominated by alkali desert scrub, desert scrub, desert wash, Joshua tree, and desert mixed shrub, areas that typically burn very infrequently (200+ years) and at high severities, most of this ecological zone on the Angeles and San Bernardino is highly departed from the historic fire regime, burning with far more frequency than historically. The Cleveland NF contains only four acres of Fire Regime V.

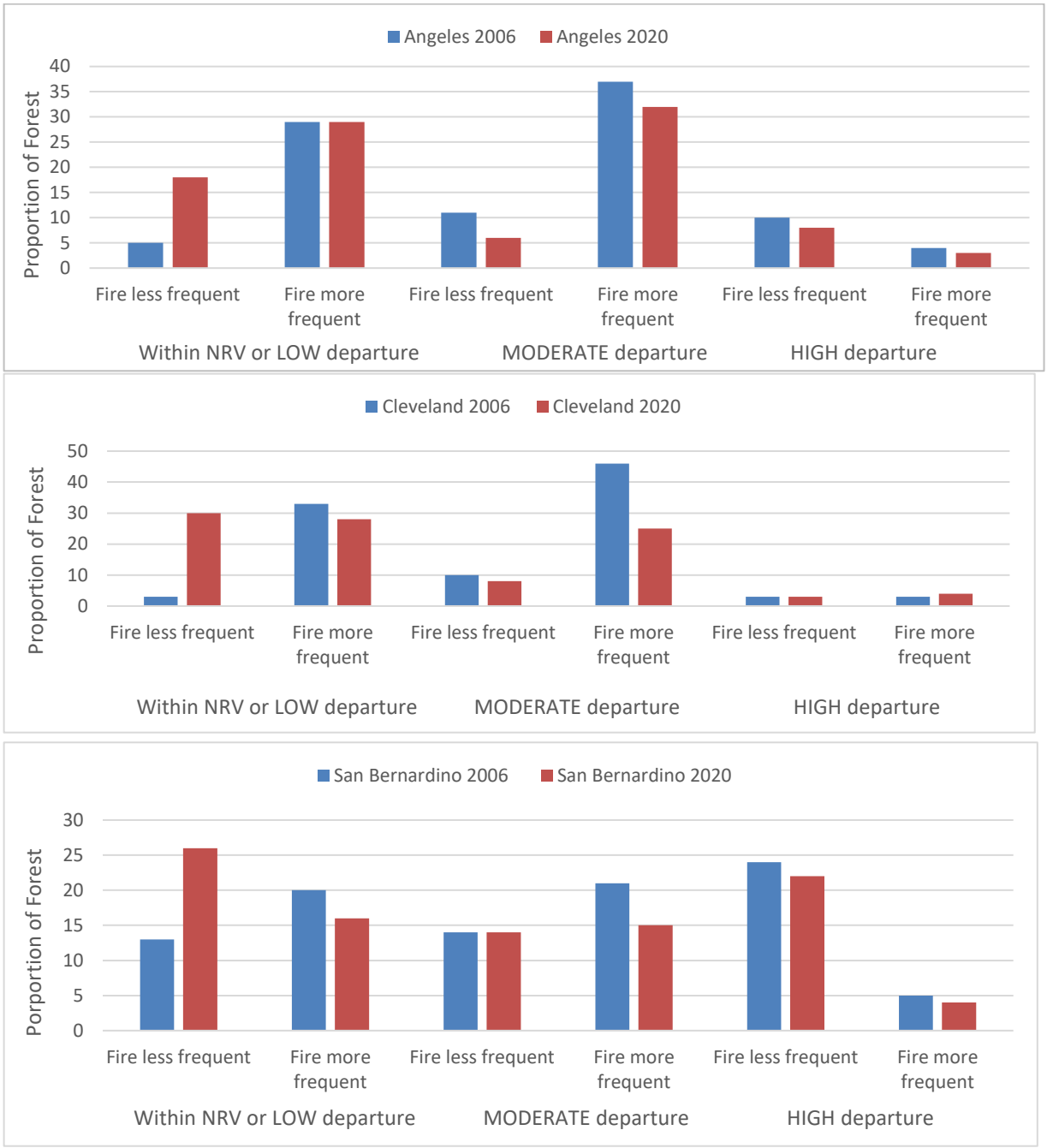

Figure 7. Proportion of Angeles (top), Cleveland (middle), and San Bernardino (bottom) National Forests that are within, moderately departed from, and highly departed from

historic fire return intervals in 2006 and in 2020.

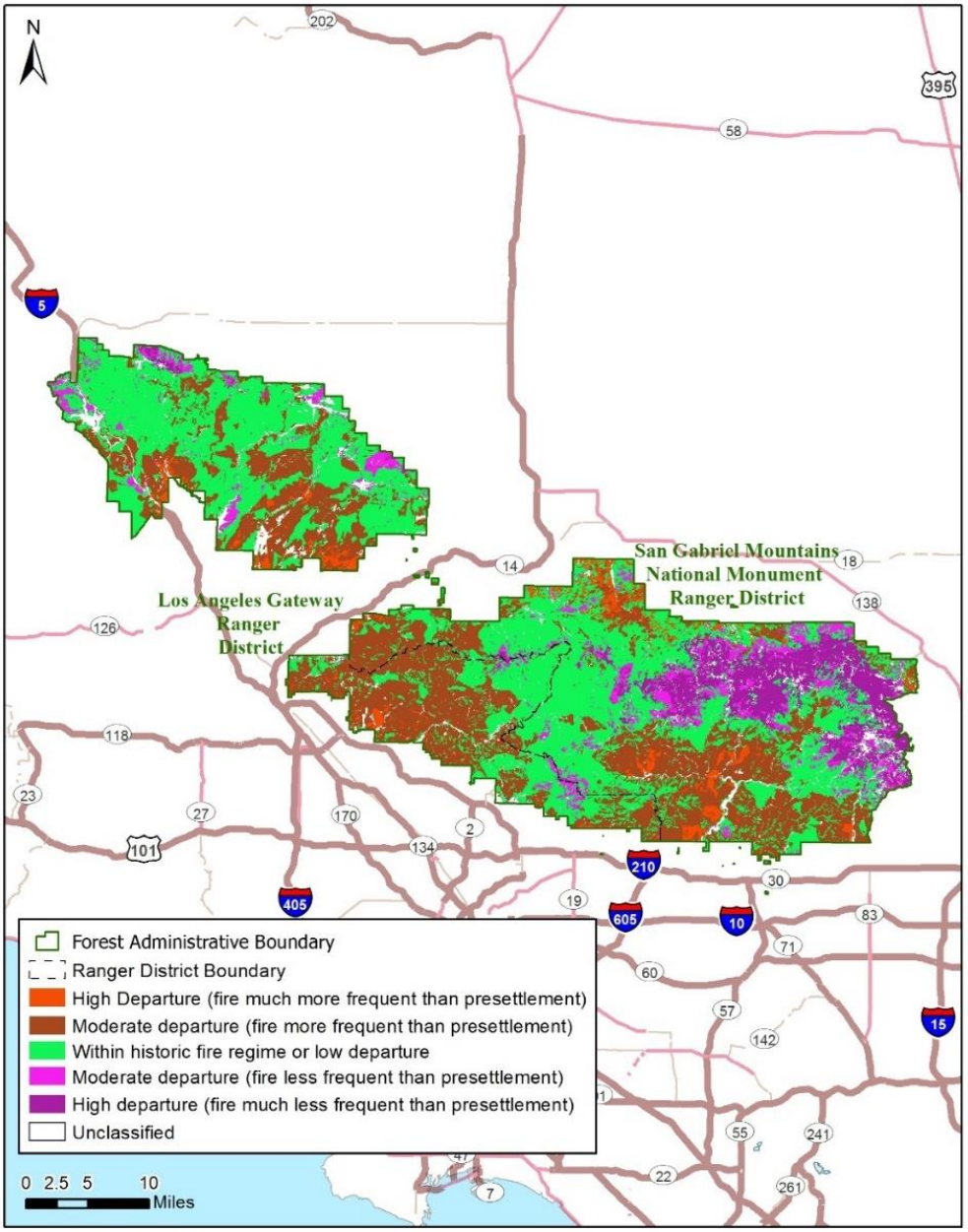

Figure 8. Fire Return Interval Departure for the Angeles National Forest. Red and brown areas are those that are burning much more frequently than historically. Purple areas are those that are burning much less frequently than historically. Green areas are within or only slightly departed from the historic fire return interval.

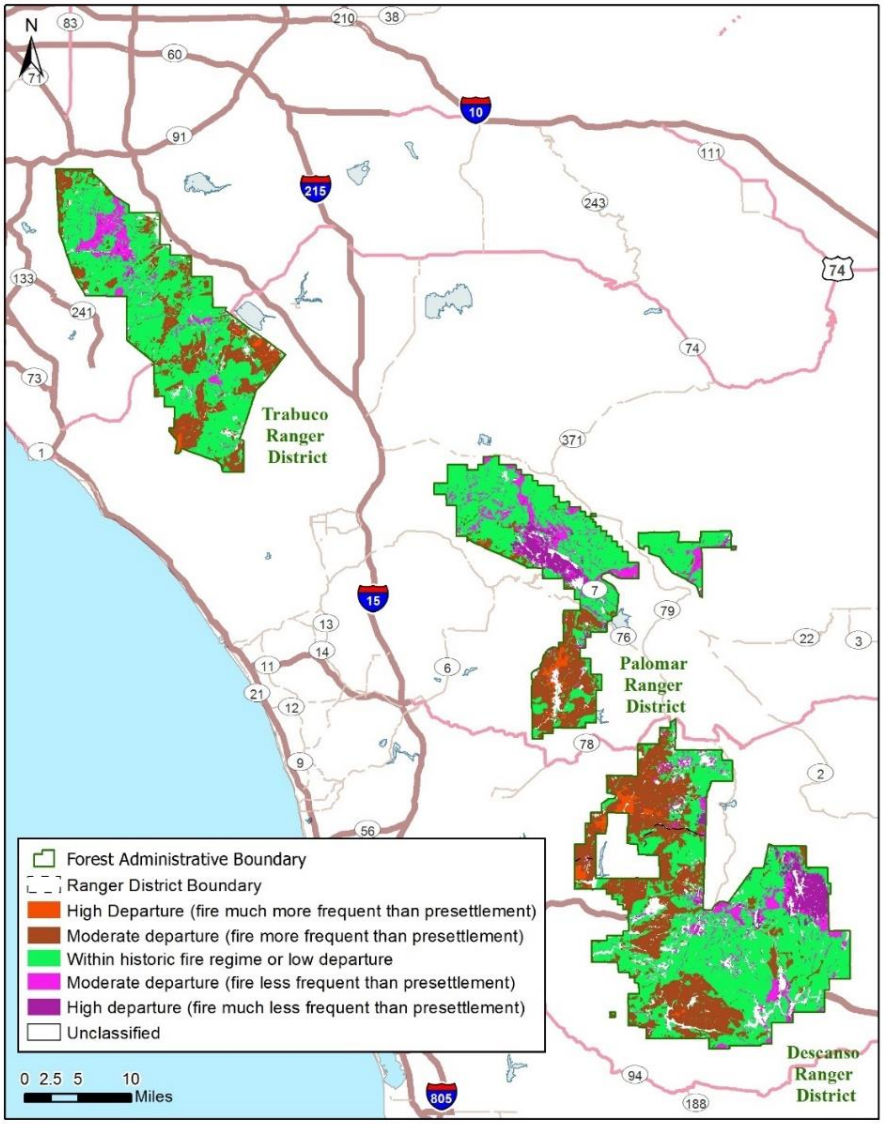

Figure 9. Fire Return Interval Departure for the Cleveland National Forest. Red and brown areas are those that are burning much more frequently than historically. Purple areas are those that are burning much less frequently than historically. Green areas

are within or only slightly departed from the historic fire return interval.

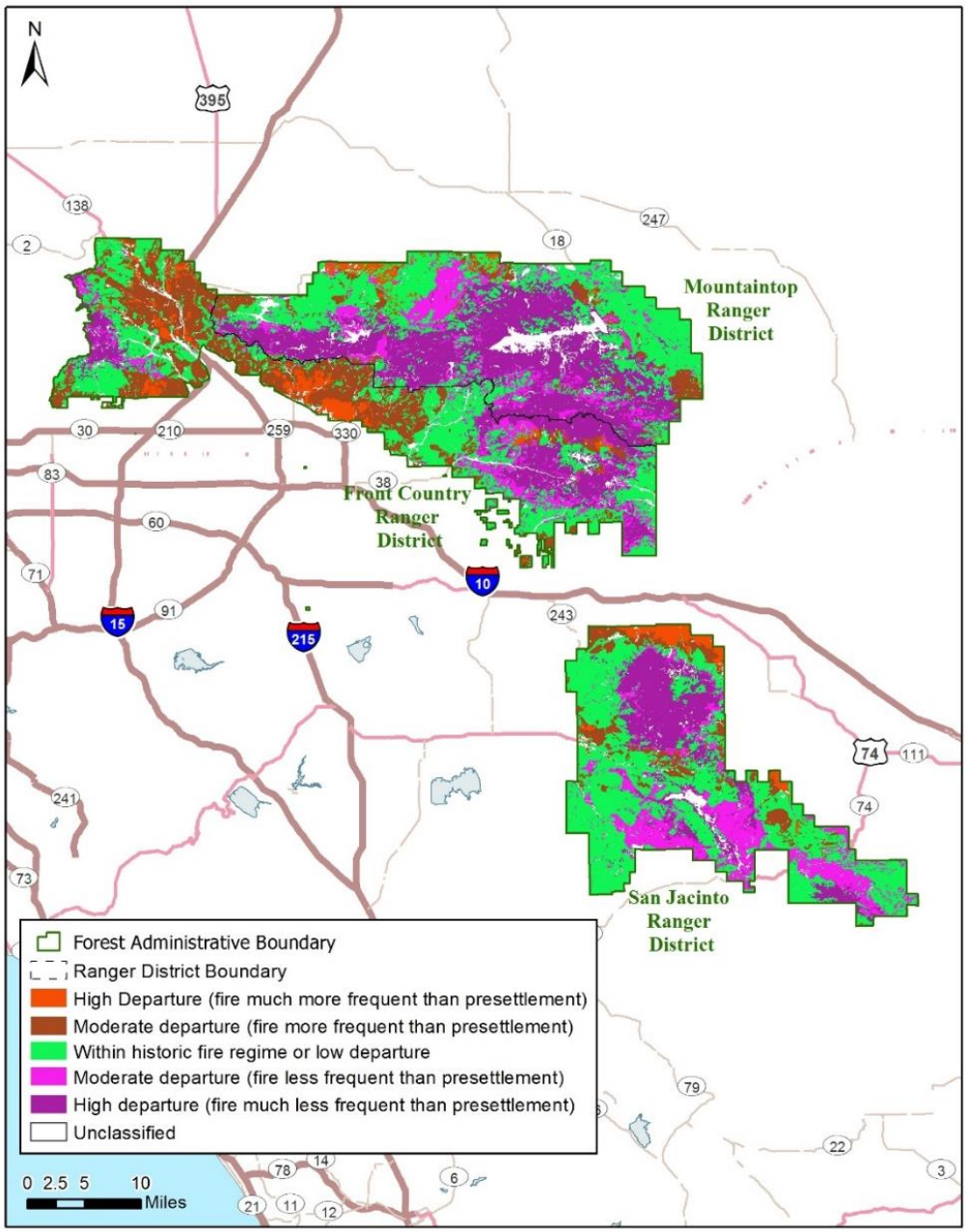

Figure 10. Fire Return Interval Departure for the San Bernardino National Forest. Red and brown areas are those that are burning much more frequently than historically. Purple areas are those that are burning much less frequently than historically. Green

areas are within or only slightly departed from the historic fire return interval.

Drought and insect – related tree mortality

Based on data for the USFS Forest Health Protection Aerial Detection Surveys, all Forests experienced a sharp increase in the acres of conifer mortality and estimated number of dead trees between 2015 and 2017. The dominant conifer species affected include white fir and yellow pine (Jeffrey and ponderosa pines). Conifer mortality since 2017 has been comparatively low. Lower and higher elevations, rather than middle elevations experienced a higher percent change in acres of mortality compared to baseline conditions but it is unclear if that is a result of higher relative mortality rates or the effects of tree densities (low and high elevations may have fewer trees). On the Cleveland National Forest, where the goldspotted oak borer is killing live oak trees, oak mortality also peaked between 2015 and 2017, and continued into 2018. The greatest concentration of dead oak trees radiates from existing goldspotted oak borer infestations. The peak in conifer and oak mortality coincided with a major drought event in the region. As drought is expected to increase over time due to climatic changes, there will be an increasing trend in either gradual or drought-induced punctuated mortality.

The Angeles National Forest conifer mortality pattern peaked in 2015 and again in 2017, 2016 mortality was relatively low (Figure 11). In 2015, yellow pine, white fir and Bigcone Douglas fir were affected by the drought but yellow pines died in the greatest numbers and largest acreage. White fir mortality lagged behind, with a small peak in 2015 and greater peak in 2017. The greatest percent change in acreage and estimated dead trees occurred at the high elevation band (8,000 feet) on the Angeles National Forest in 2015.

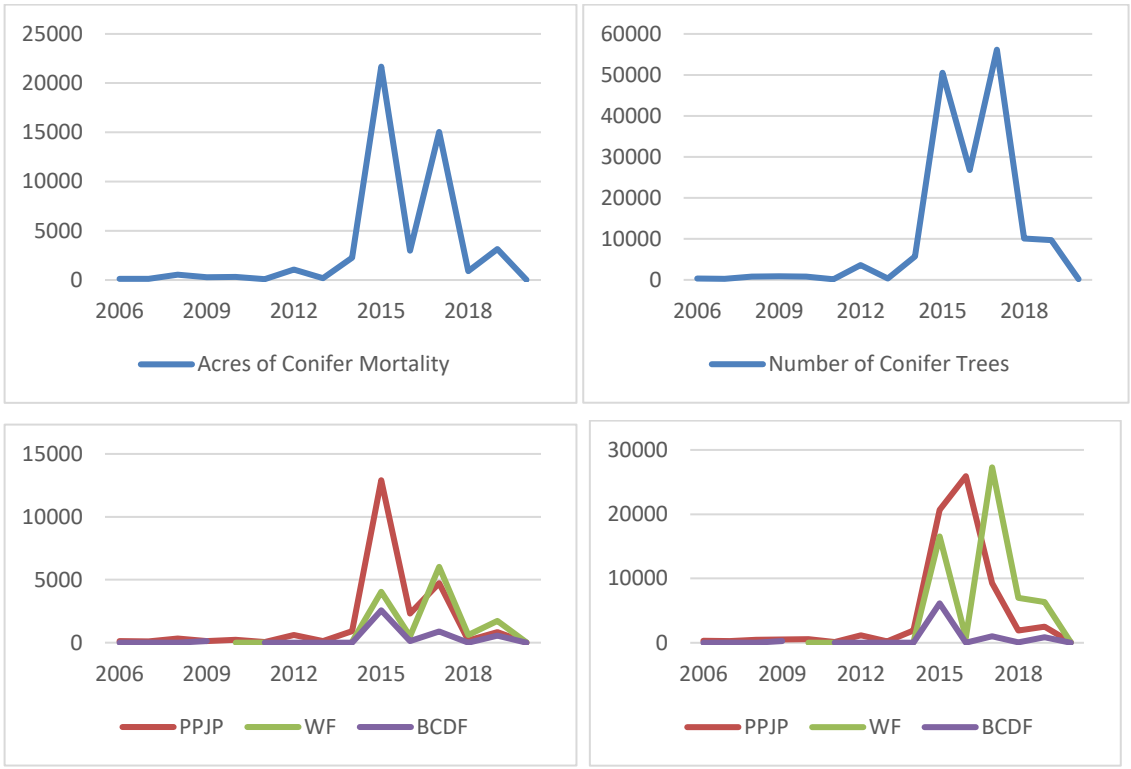

Figure 11. Acres of conifer mortality (top left) and estimated number of dead conifers (top right) on the Angeles National Forest (USFS Forest Health Protection Aerial Detection Surveys). Acres (bottom left) and estimated number of dead (bottom right) white fir (WF), yellow pine (PPJP = pinyon pine, Jeffrey pine), and Bigcone douglas fir (BCDF) trees on the Angeles National Forest.

The Cleveland National Forest mortality spiked in 2015 and ended earlier than the other two Forests (Figure 12). The mortality event also affected far fewer acres and trees compared to the other two Forests. However, of the three Forests, the Cleveland National Forest had the highest percent change in tree mortality from 2006 numbers. Yellow pine trees were more affected by the mortality event than any other species group. In fact, Bigcone Douglas fir mortality affected fewer than 120 acres and 60 trees. Unlike the Angeles National Forest, the peak mortality on the Cleveland occurred at the lower elevation band (2,000 feet).

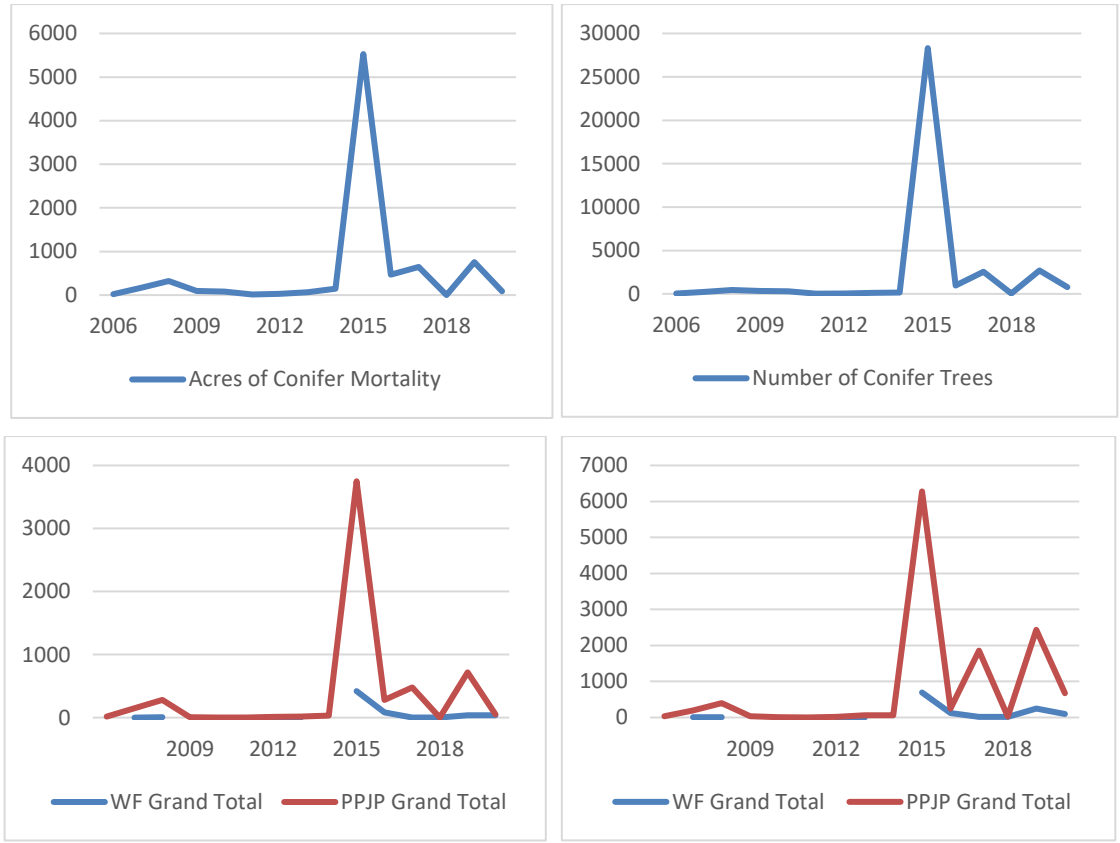

Figure 12. Acres of conifer mortality (top left) and estimated number of dead conifers (top right) on the Cleveland National Forest (USFS Forest Health Protection Aerial Detection Surveys). Acres (bottom left) and estimated number of dead (bottom right) white fir (WF) and yellow pine (PPJP = pinyon pine, Jeffrey pine) trees on the Cleveland National Forest.

The Cleveland National Forest experienced a peak in live oak mortality also during the drought period (2015-2017) (Fire 13). The estimated number of dead oak trees also remained elevated in 2018. The greatest concentration of annual dead oak trees tends to be on the leading edge of the goldspotted oak borer (GSOB) infestation as the beetles kill the most susceptible trees first adjacent to those already affected. On the

Descanso Ranger District, GSOB-caused tree mortality was greatest from 2006-2017. By 2015, oak mortality began to increase on the Palomar Ranger District. GSOB was introduced to the Trabuco Ranger District through infested firewood and was first detected on National Forest lands in 2017 within Blue Jay and Falcon campgrounds. Active management within those campgrounds included removing GSOB-infested trees to reduce local population levels and preventative insecticide sprays to limit further infestation of trees. As a result, GSOB-related oak mortality has been limited on the Trabuco Ranger District. In 2019, oak mortality was concentrated on the Palomar Ranger District near Palomar Mountain.

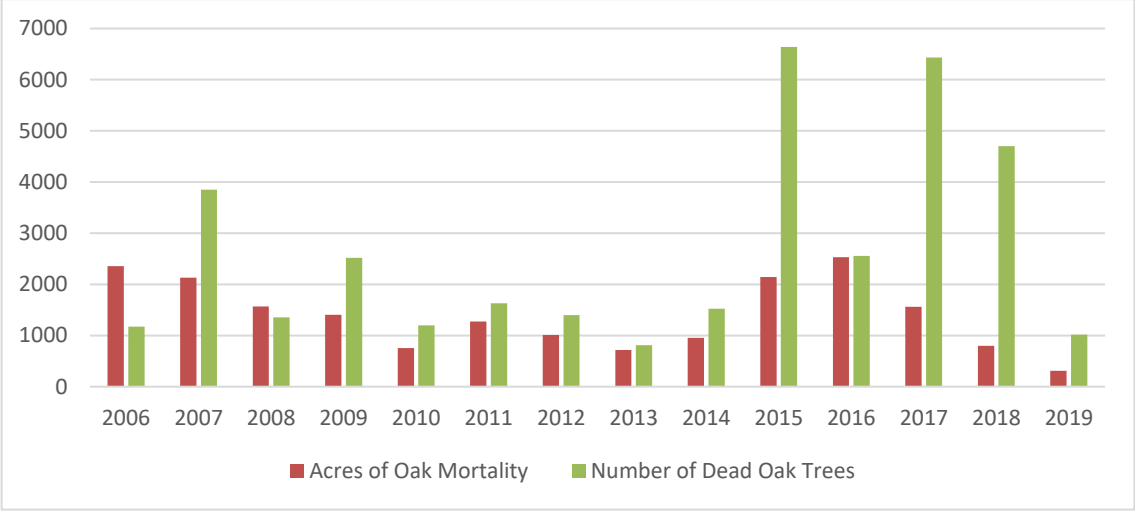

Figure 13. Annual estimates of acres of new oak mortality and number of dead oak trees on the Cleveland National Forest from 2006 to 2019 (USFS Forest Health Protection Aerial Detection Surveys).

Conifer mortality on the San Bernardino National Forest spiked the most in 2017 compared both to previous years and the other two Forests (Figure 14). This Forest had the most mortality (acres and numbers of trees) of the three Forests, but this result may reflect the fact that the San Bernardino has more conifer trees. Acres of Jeffrey pine and Ponderosa pine peaked in 2015 and then again in 2017 and a smaller peak in 2019. White fir experienced greater mortality than the pines showing one strong peak in 2017. Bigcone Douglas fir mortality also peaked in 2017 but in numbers far below the other species (< 2500 acres, < 4000 trees). Like the Cleveland National Forest, the elevation band that has experienced the most change in tree mortality is the lower elevation (3,000 feet).

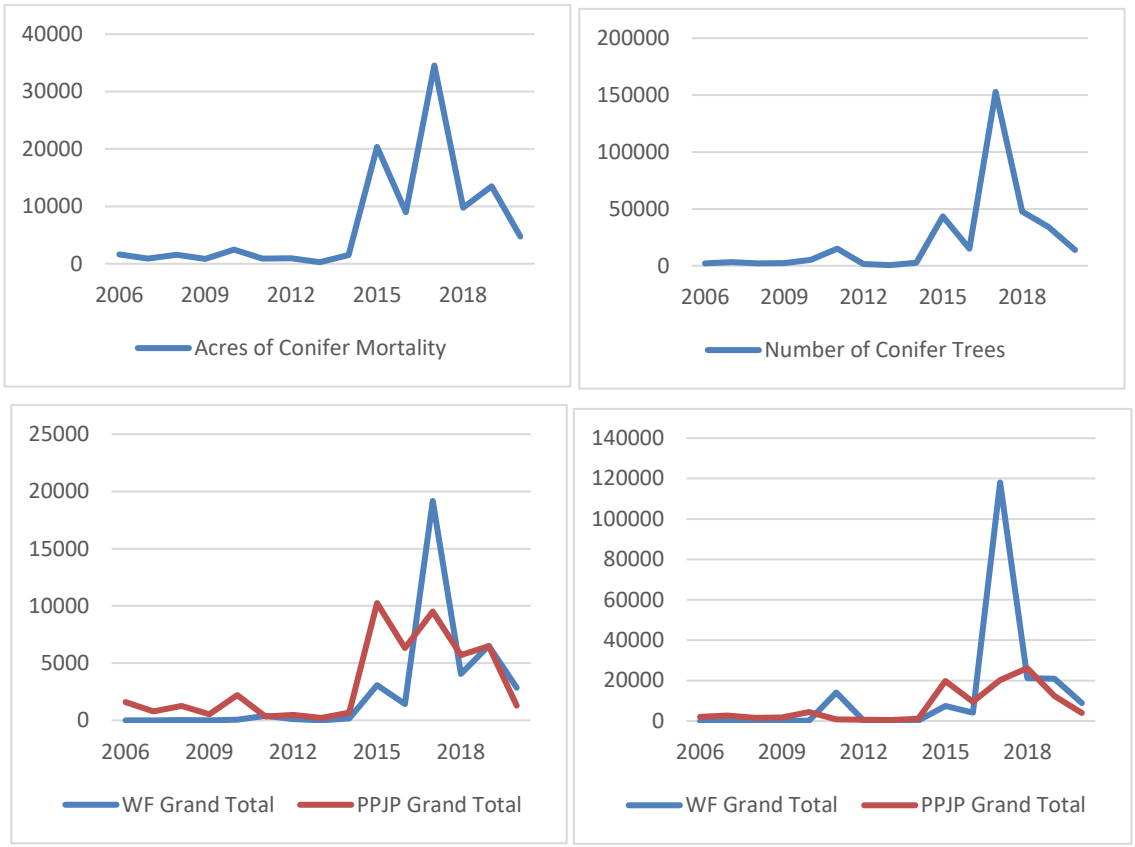

Figure 14. Acres of conifer mortality (top left) and estimated number of dead conifers (top right) on the San Bernardino National Forest (USFS Forest Health Protection Aerial Detection Surveys). Acres (bottom left) and estimated number of dead (bottom right) white fir (WF) and yellow pine (PPJP = pinyon pine, Jeffrey pine) trees on the San Bernardino National Forest.

The three Forests are part of a multi-jurisdictional, collaborative partnership with the Climate Science Alliance, Institute for Ecological Monitoring and Management at San Diego State University, and the Southwest Climate Adaptation Science Center to develop a scientific assessment and create a conservation strategy for southern

California's montane forests. The Southern California Montane Forest Project is guided by stakeholder input and is intended to help identify vulnerabilities and challenges facing montane forests (conifers and oaks) and identify the opportunities and strategies for increasing forest resilience.

Shrubland conversion to non-native grasses and herbs

There has been an increase in the acres and percent of the shrubland landscape that has type converted to non-native annual grasslands between 2009 and 2018 (the most recent years data were available). However, the proportion of non-native annual grasslands measured is low (1%) and the San Bernardino saw a decrease between 2017 and 2018.

All three Forests have experienced an increase in the acres and percent of the shrubland landscape that has converted to non-native annual grasslands. This pattern has not been continuous – the Forests experienced an initial decrease in converted acres generally between 2009 and 2013 before increasing again (Figure 15). The Angeles and Cleveland National Forests mirror this trend, but the San Bernardino experienced a decrease in the acres of non-native annual grassland between 2017 and 2018, the most recent years of available data (Figure 16). The percentage of non-native annual grassland measured remains relatively low (1%).

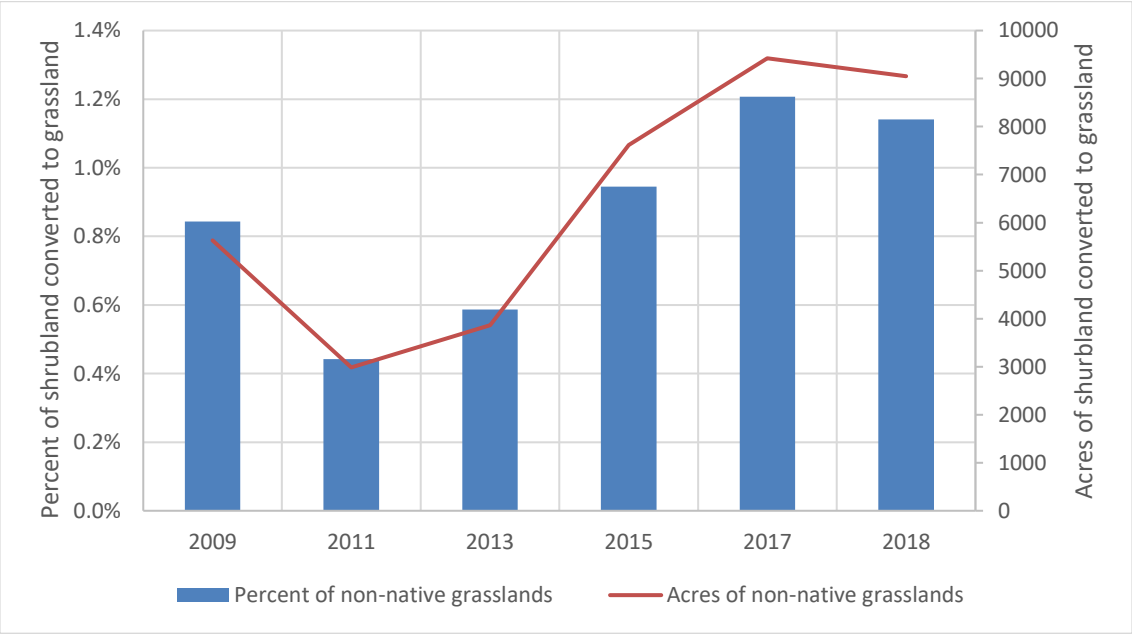

Figure 15. Trend in acres and percent of shrubland converting to non-native annual grasslands on the Angeles, Cleveland, and San Bernardino National Forests between 2009 and 2018. Any areas burned in the last 10 years were not included in the analysis because of the potential to inflate conversion trends due to native fire-following grasses and herbs. The threshold for conversion was 50% meaning that any area that

previously was considered shrubland (per Wieslander historic map) and is now >50% herb cover would be considered converted.

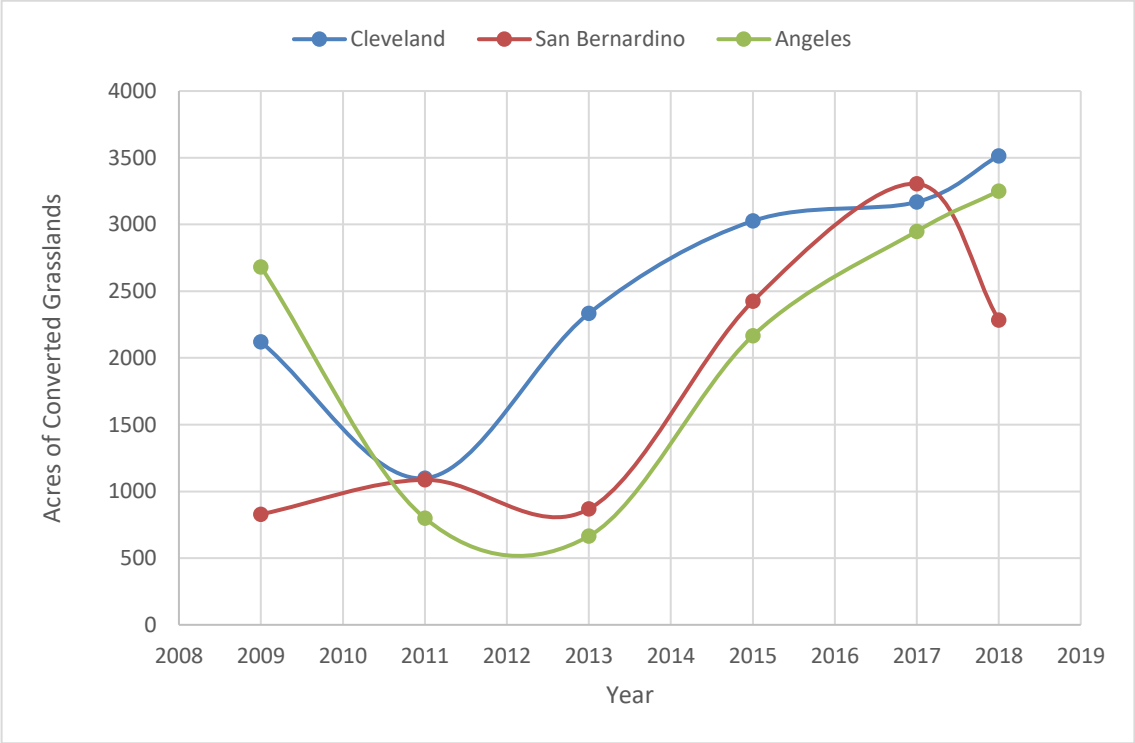

Figure 16. Trend in acres of non-native annual grasslands on the Angeles, Cleveland, and San Bernardino National Forests between 2009 and 2018. Any areas burned in the last 10 years were not included in the analysis because of the potential to inflate conversion trends due to native fire-following grasses and herbs. The threshold for conversion was 50% meaning that any area that previously was considered shrubland (per Wieslander historic map) and is now >50% herb cover would be considered converted.