Comment letters received after the close of the Draft PEIR public review period

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California State Senate

SENATOR
CATHLEEN GALGIANI
FIFTH SENATE DISTRICT

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August 9, 2019

Board of Forestry and Fire Protection
Attn: CalVTP
PO Box 944246
Sacramento, CA 94244-2460

To Whom it May Concern:

Extreme wildfire risk is becoming the new norm in California. Last year saw the largest recorded fire in California (the Mendocino Complex), and the deadliest and most destructive (the Camp Fire). Fire season is becoming a year-round problem. These wildfires cause significant damage to life and property, serious air quality problems and jeopardize California's ability to meet its climate goals. Many of the areas burned will suffer permanent ecological damage. California could end up with many of its forests becoming weeds and grasses because of these intense fires.

Across our state, bigger, more frequent and more intense wildfires are having significant health impacts and destroying our communities at an alarming rate. As these losses continue to mount it has become clear that public and private partners need more tools to implement wide-ranging fire prevention programs in their communities. The California Vegetation Treatment Program Programmatic Environmental Impact Report (CalVTP) is a California Environmental Quality Act (CEQA)-compliant program that would create a streamlined process for communities to engage in prevention projects that would reduce hazardous vegetative fuel conditions and restore ecosystem resiliency.

A combination of manmade and natural factors has resulted in drastic increases in economic losses, resulting from not only wildfire suppression, but also lost lives, homes and infrastructure. This crisis requires a statewide strategy. The ability to tier the environmental analysis for these projects off a statewide programmatic environmental impact report (PEIR) would substantially reduce costs to communities and allow them to timely address hazardous vegetative fuel and potentially reduce catastrophic losses.

The CalVTP provides a framework for communities to plan and implement fuel reduction and ecosystem resiliency projects to protect their landscapes from wildfire. I would like to lend my support to the Board of Forestry and Fire Protection in the development of the CalVTP.

Sincerely,

Cathleen Galgiani

Cathleen Galgiani
Senator, 5th District

Sea and Sage Audubon
P.O. BOX 5447, IRVINE, CA 92616-5447
(949) 261-7963

August 13, 2019

VIA ELECTRONIC MAIL

Board of Forestry and Fire Protection
ATTN: CalVTP
PO Box 944246
Sacramento CA 94244-2460
CalVTP@bof.ca.gov

RE: Draft Program Environmental Impact Report Regarding a Proposed Statewide Vegetation Treatment Program (SCH 2019012052)

Gentlepersons;

Sea and Sage Audubon Society (Sea and Sage) appreciates the opportunity to submit comments on the Draft Program Environmental Impact Report for the State's proposed California Vegetation Treatment Program.

Sea and Sage is a non-profit organization with over 3500 members in Orange County, California, incorporated in 1959. Our mission is to protect birds and other wildlife, and their habitats, through education, citizen science, research, and public policy advocacy.

Sea and Sage asks to be on record endorsing the comments by the Center for Biological Diversity, the Endangered Habitats League, the California Chaparral Institute and the California Native Plant Society, San Diego Chapter. These four response comments were submitted separately on 8-9-19.

The urgency of addressing wildfire issues in the state is demonstrated by the catastrophic wildfires in northern and southern California these past two years. However, at a time when the Board should be prioritizing the safety and protection of existing communities and developing strategies for minimizing the number of people and homes that are placed in harm's way, it is instead proposing to waste precious State resources on vegetation treatment strategies that leading wildfire experts agree are ineffectual at protecting lives and property from the most destructive wildfires. Indeed, the proposed CALVTP would serve to facilitate the expansion of development into extremely hazardous wildlands. And it does so at the cost not only of the State's limited fire-fighting resources, but of much of our natural and biological heritage, and at a time when it is so important to preserve our forests for their role in absorbing carbon dioxide generated by human activities.

Thank you for this opportunity to comment.

Sincerely,

Susan Sheakley
Conservation Chair
Sea and Sage Audubon Society
www.seaandsageaudubon.org

Sea and Sage Audubon Society's mission is to protect birds and other wildlife, and their habitats, through education, citizen science, research, and public policy advocacy.

Hannigan, Edith@BOF

From:	Dan Silver <dsilverla@me.com>
Sent:	Wednesday, August 28, 2019 8:32 AM
To:	CALVTP@BOF
Cc:	Laurel L. Impett
Subject:	Draft Program Environmental Impact Report Regarding a Proposed Statewide Vegetation Treatment Program (SCH 2019012052)
Attachments:	K2019_Syphard type conversion_Ecosphere.pdf

Warning: this message is from an external user and should be treated with caution.

Gentlepersons:

Please find a scientific article on type conversation for submittal into the administrative record for this project.

Dan Silver
Endangered Habitats League

Enclosures

Syphard, et al, "Extent and drivers of vegetation type conversion in Southern California chaparral," 2019

Dan Silver, Executive Director
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Ecosphere

Extent and drivers of vegetation type conversion in Southern California chaparral

Alexandra D. Syphard,[1,2,]† Teresa J. Brennan,[3] and Jon E. Keeley[3,4]

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Citation: Syphard, A. D., T. J. Brennan, and J. E. Keeley. 2019. Extent and drivers of vegetation type conversion in Southern California chaparral. Ecosphere 10(7):e02796. 10.1002/ecs2.2796

Abstract. The native chaparral shrublands of Southern California support exceptional biodiversity and provide critical ecological services, but increased fire frequency threatens to extirpate much of the chaparral due to long regeneration times needed between fires for many species. When short fire intervals inhibit shrub recovery, this favors invasion of exotic herbaceous species, and vegetation type conversion from woody shrubs to grassland is therefore a serious ecological concern in this biodiversity hotspot. Despite a history of field studies documenting the detrimental effect of short-interval fire, the extent of vegetation type conversion and the conditions under which it occurs have not been documented at a landscape scale. Our objective was thus to provide an unbiased assessment of how and how much vegetation type conversion is occurring in Southern California chaparral. We used a chronosequence of aerial photographs to quantify percentage woody and herbaceous cover change from 1953 to 2016 across randomly sampled plots in San Diego County, then related conversion and decline to a range of explanatory variables including fire, proximity to human disturbance, and biophysical landscape characteristics. Within the 63-yr study period, there was substantial net woody cover loss, and in the plots that were initially more than 75% woody cover in 1953, 59% experienced a decline, with a mean woody cover loss of 22.5%. Of these, 28% heavily type-converted to the point that herbaceous vegetation covered more than 50% of the plot. The top drivers for woody conversion and decline included a fire interval shorter than 15 yr and total number of fires, actual evapotranspiration, and elevation. Although human land use variables were not strong independent contributors to either chaparral conversion or decline, 26% of the initial vegetated plots were directly converted to development or other human disturbance types. The combination of direct habitat loss and unintentional vegetation type conversion represents a substantial ecological impact in Southern California that can have far-reaching impacts via loss of ecological services and by increasing the flammability of the landscape in general. Efforts to reduce fire frequency will be key to preventing further losses.

Key words: annual grass; evapotranspiration; fire interval; habitat loss; invasive species; wildfire.

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Introduction

The most extensive vegetation type in Southern California consists of a diversity of drought-tolerant, evergreen, woody shrub species known as chaparral. The morphological and physiological characteristics of these shrublands, characteristic of all Mediterranean ecosystems (Keeley et al. 2012), contribute to numerous ecosystem services critical to human health and society

(Underwood et al. 2018) and support the rich biodiversity of the region (Keeley 2005). As in other Mediterranean regions, which are all biodiversity hotspots, chaparral is threatened by rapid global change, with too-frequent fire often ranking as the top threat (Franklin et al. 2014).

Although chaparral is generally resilient to periodic wildfire (Keeley and Syphard 2018*a*), uncharacteristically short intervals between fires may prevent sufficient post-fire recovery and gradually lead to replacement by alien herbaceous vegetation (Keeley and Brennan 2012, Syphard et al. 2019). Evidence for fire's potential to facilitate unintentional chaparral type conversion to grassland in California has been documented since the 1920s (Cooper 1922). Intentional type conversion using fire was practiced by Native Americans, Euro-American settlers, and middle 20th-century ranchers who did repeated burning to convert these dense woody shrublands into grasslands for economic reasons (Burcham 1955, Keeley and Fotheringham 2003). Recently, the role of fire in driving vegetation type changes in a number of conifer forest systems has been documented for western North America (Davis et al. 2019, Turner et al. 2019) and globally (Pausas 2015).

Despite the ecological importance of chaparral and its potential for decline under repeated fire, few efforts have been made to document the extent of chaparral vegetation type conversion across Southern California landscapes or to quantify the environmental conditions under which this change is most likely, in part because chaparral has historically been under-valued (Rundel 2018). On the other hand, there have been multiple studies evaluating the decline and conversion of drought-deciduous sage scrub species to herbaceous vegetation (Minnich and Dezzani 1998, Talluto and Suding 2008, Cox et al. 2014). Sage scrub, while often intermixed with chaparral, is generally located in lower-elevation parts of the landscape and tends to be more resilient to frequent fire (Westman and O'Leary 1986) and more vulnerable to nitrogen deposition (Fenn et al. 2010) than chaparral.

So far, most research on short-interval fire effects in chaparral has involved field experiments showing different species' sensitivities to short-interval fires relative to post-fire traits, that is, according to functional groups (e.g., Zedler et al. 1983, Haidinger and Keeley 1993, Keeley and Brennan 2012). Results of these studies, consistent with simulation experiments (Syphard et al. 2006), have found the most fire-sensitive chaparral species are obligate seeders that depend upon fire-cued seed germination and require a decade or more to recover after fire (Zedler et al. 1983, Jacobsen et al. 2004, Lippitt et al. 2012). Other work has shown that even resprouting chaparral can be eliminated if fire is frequent enough (Haidinger and Keeley 1993, Keeley and Brennan 2012). Although intervals of at least 5 to more than 15 yr are believed to be required to allow sufficient time for post-fire chaparral recovery (Zedler 1995), it remains unclear whether there is a specific minimum-interval threshold at which type conversion is most likely.

While our understanding of chaparral type conversion has come from localized field studies, increasing fire frequency in Southern California has the potential to drive widespread vegetation change, not only in coastal sage scrub ecosystems (Talluto and Suding 2008), but also in chaparral-dominated landscapes (Syphard et al. 2019), and this has prompted the need for more work at a landscape scale. Lippitt et al. (2012) found evidence for landscape-level chaparral displacement where fire intervals were shorter than five years, in lower-elevation areas near chaparral ecotones with xeric slopes and low moisture availability. This is consistent with other studies that documented shifting dominance from woody to herbaceous cover at low elevations or where there are low soil water moisture or drought conditions (Meng et al. 2014, Park et al. 2018, Syphard et al. 2019). Proximity to human disturbance has also been a significant correlate (Syphard et al. 2019).

Regarding fire interval, Meng et al. (2014) concluded, after failing to detect significant type conversion after short-interval fire via remote sensing across paired plots after 25 yr, that large-scale vegetation type conversion is unlikely to occur. However, it should be recognized that they were not documenting changes in vegetation over time, but rather they were using different sites at different points in time and making inferences about the role of their different histories. The gold standard in type conversion studies must be examination of how actual vegetation changes over time, and thus, we need studies that follow the same sites over time.

Beyond understanding the role of fire and other geographical co-variates in facilitating type conversion, there is a pressing need to determine whether widespread change is actually occurring. Despite the doubt raised by Meng et al. (2014), simple map overlays from the 1930s to 2013 suggest that large swaths of the Southern California landscape have already converted from shrubland to grassland, in areas of high fire frequency (Syphard et al. 2018). If these maps reflect real changes, this represents a serious ecological issue. The only way to truly quantify change is via long-term empirical work; but given the paucity of long-term field data, chronosequence methods using remote sensing or aerial photography offer the only alternative.

Recent work in the Santa Monica Mountains (Syphard et al. 2019) was the first to use historical aerial photography to quantify a chronosequence of chaparral vegetation change across an entire landscape and relate it to a range of drivers and landscape characteristics, although a similar approach was used in the San Francisco Bay area to document change among different vegetation types (Russell and McBride 2003). Although the work in the Santa Monica Mountains suggested that chaparral type conversion has likely been substantial, the results may have been biased because samples were selected purposely to identify plots that both had and had not converted from chaparral to herbaceous vegetation.

In this study, we aimed to provide an assessment of how much type conversion has occurred in Southern California chaparral by quantifying the percentage woody cover change from 1953 to 2016 in 916 randomly sampled plots distributed across historical aerial photographs in San Diego County. 1953 and 2016 were the earliest and latest dates for which we could obtain continual coverage across the study region. Similar to the approach used in Syphard et al. (2019) as described below, we calculated the percentage cover of woody shrublands and herbaceous vegetation, in addition to developed or disturbed land in all plots in both years, and then related decline of woody cover and conversion to herbaceous vegetation to a range of explanatory variables representing fire, proximity to human disturbance, and biophysical landscape characteristics. We asked the following questions:

1. How is the cover of woody chaparral shrublands changing over time, and how much is converting to herbaceous vegetation?
2. Is short-interval fire a key control of this decline, and what is the minimum fire interval where this change is significant?
3. What are the important geographical factors associated with unintentional woody cover decline, and are these similar to those in the Santa Monica Mountains?

Methods

Study area

The study area included the portion of San Diego County that overlaps the South Coast Ecoregion in California (Miles and Goudey 1997; Fig. 1), where chaparral is the most extensive vegetation, often distributed in a mosaic with native and exotic grasslands, drought-deciduous sage scrub, oak woodlands, and mixed conifer forests in higher elevations. San Diego County has a Mediterranean climate with cool, wet winters and hot, dry summers, and its high topographic heterogeneity and climatic heterogeneity contribute to exceptionally high levels of biodiversity; yet, the region has also experienced tremendous population growth and urban expansion, and thus also has the most threatened and endangered species in the continental United States (Dobson et al. 1997). The natural fire regime is characterized by periodic large, high-intensity crown fires driven by hot, dry Santa Ana winds that recur every autumn in addition to smaller fires that occur in the summer (Jin et al. 2015). More than 95% of fires are caused by humans (Keeley and Syphard 2018*b*); thus, fire frequency has increased across much of the landscape in response to population growth and urban expansion, and intervals between fires are now much shorter than pre-Euro-American settlement conditions (Safford and Van de Water 2014). The conversion of chaparral to herbaceous vegetation has already been documented in some parts of the county (Keeley and Brennan 2012, Lippitt et al. 2012).

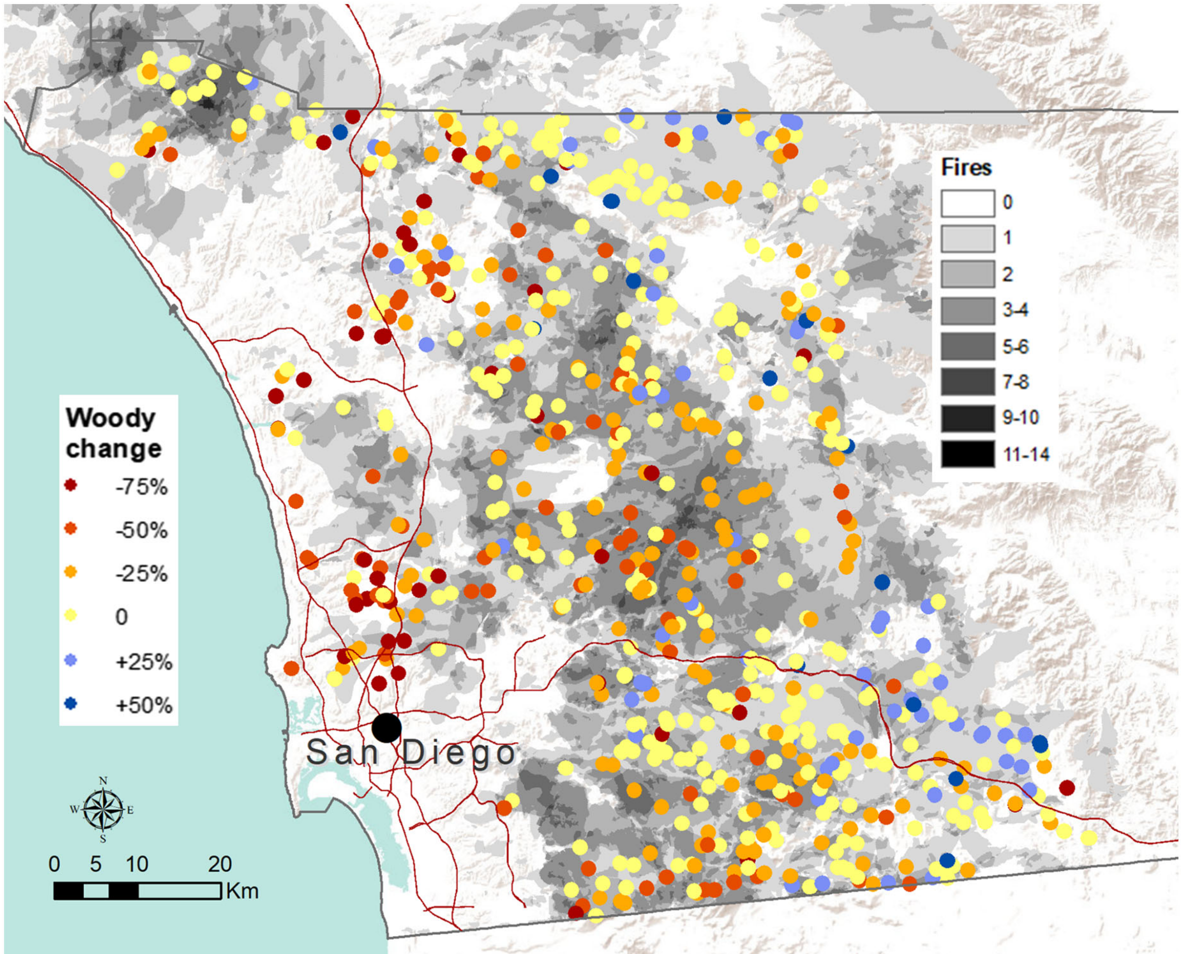

Fig. 1. Map of San Diego County with 771 plots overlaid showing the percentage change in woody cover from 1953 to 2016. These are the original 916 points with 145 removed due to fire within five years of the image date.

Random sampling and image interpretation

To quantify the extent and to identify the drivers of chaparral vegetation change, we generated a random sample of 1000 points, with a minimum of 90 m between points to avoid plot overlap, across the entire area mapped as chaparral in the 1930s on a historical vegetation map (Kelly et al. 2005). While chaparral may be interspersed with coastal sage scrub in some areas, restricting the initial conditions to chaparral in the 1930s map ensured that chaparral dominated the initial conditions. We then recorded the fates of these plots by 2016, allowing an unbiased sampling of potential change across chaparral-dominated areas of the vegetated landscape. Due to lack of imagery in some areas, we removed 84 plots, leaving an initial sample size of 916. As in Syphard et al. (2019), we created 30-m buffers around all points and quantified the type and percentage of cover within those 0.28-ha plots for image dates 1953 and 2016, which were the earliest and latest dates for which complete county coverage was available. The 1953 data were collected from images acquired from the University of California Santa Barbara Map and Image Library (http://mil.library.ucsb.edu/ap_indexes/FrameFinder), Flight AXN-1953, and were at the scale of 1:20,000, and the 2016 data were collected from images acquired from the National Agriculture Imagery Program (NAIP), available on an ArcGIS Server (https://gis.apfo.usda.gov/arcgis/rest/services), with a resolution of 60 cm.

To quantify woody cover transition and decline, we assigned each plot a number on an interval scale corresponding to percentage cover of woody chaparral vegetation, bare ground and grass, rock, urban development (paved roads and structures), or other type of human disturbance (e.g., agriculture, trails and dirt roads, fuel breaks). We were able to easily discern woody chaparral from herbaceous vegetation via the texture in the images. However, we could not discern drought-related dieback or mortality, as woody skeletons remain on the landscape until the next fire and still show chaparral. Therefore, the analysis of woody cover change did not account for drought-related adult mortality. For statistical analysis of the drivers of change, percentage cover was classified into four equal intervals of 25% cover of each class (0–25%; 26–50%; 51–75%; and 76–100%). To further characterize the nature of vegetation change, we added additional classes to indicate where there were almost pure stands of a cover type (95–100%) in addition to stands where the cover type was absent or minimally present (0–5%).

We overlaid a map of fire perimeters on the plots (Cal Fire perimeter data; http://frap.fire.ca.gov/data/frapgisdata-sw-fireperimeters_download), and further assessed burn scars in the imagery to identify and delete any plot that had experienced, or appeared to have experienced, a partial or complete burn within 5 yr of either image date (i.e., from 1948 to 1953 and from 1911 to 2016, n = 145). We did this to ensure that early post-fire recovery vegetation was not mistaken for longer-term vegetation change. Because the objective was to quantify change in woody cover (either positive or negative), we also deleted plots that had evidence of human disturbance or urban development in 1953 (n = 110) to ensure that the initial state was purely vegetated regardless of cover type. We quantified change in vegetation cover by plotting the distribution of cover type percentages in both time periods and by overlaying plots and subtracting the cover value (ordinal scale 1–4) in 1953 from that in 2016.

For statistical analysis of the drivers of chaparral decline and conversion to herbaceous vegetation, we used the subsample of the plots that were initially pure or almost pure stands of chaparral, that is, they had at least 75% woody cover in 1953. This restriction to relatively intact stands of chaparral ensured that the statistical analysis was focused on identifying and isolating those factors associated with chaparral type conversion and not to confound those with other types of vegetation change. This required the initial stand conditions to be chaparral. We further deleted plots that had either become developed or disturbed by human land use by 2016 because our focus here was on the drivers of unintentional vegetation type change of chaparral. This resulted in a sample size of 311 plots for statistical analysis of drivers of change. As in Syphard et al. (2019), we performed statistical analysis for two binary dependent variables. For the first, plots were split based on the criterion of 50% cover conversion from woody to herbaceous over the 63-yr study period (i.e., to the point in which herbaceous cover occupied at least 50% of the plot, hereafter "chaparral conversion"). For the other, we split the plots based on whether woody chaparral experienced at least a 25% conversion to herbaceous (hereafter "chaparral decline").

Explanatory variables

To identify the most important landscape drivers of vegetation type conversion, we considered a similar suite of landscape-scale variables as our analysis in the Santa Monica Mountains (Syphard et al. 2019), although we updated the list with a couple of additional variables (Table 1). Regardless of the native resolutions of the explanatory variables, we extracted data values from each spatial layer to correspond with our 30-m plot areas.

It is well established that soil characteristics and water balance mediate plant development and productivity (Franklin 1995), and potentially post-fire recovery, so we evaluated soil available water capacity (AWCL), derived from the California State Soil Geographic Database (STATSGO; Shirazi et al. 2001), which was one of the most important variables in the Santa Monica Mountains. In addition, we considered two variables we hypothesized may better represent soil moisture availability or drought conditions, including climatic water deficit and actual evapotranspiration, but because they were highly correlated, we only proceeded with actual evapotranspiration (AET). We obtained AET from a suite of climatic and water balance data produced by Flint and Flint (2012) using

Table 1. Description and scale of variables used in statistical analysis of vegetation type conversion in San Diego County, California, USA.

Variable	Description and source	Scale
Vegetation change (dependent variables)		
Chaparral conversion	Plot that was mostly chaparral in 1953 and mostly grass in 2016, compared to no vegetation change or lower percentage decline	30-m buffers around points (0.28 ha), binary
Chaparral decline	Plot that was fully chaparral in 1953 that experienced at least a 25% conversion to grass in 2016, compared to no vegetation change	30-m buffers around points (0.28 ha), binary
Explanatory variables		
Nitrogen deposition	Annual deposition or reduced and oxidized nitrogen (Tonnesen et al. 2007)	4 km, kilogram of nitrogen per hectare
Number of fires	Total number of fires that occurred since 1898, Cal Fire perimeter database	30 m, calculated at plot location
Minimum fire interval	Shortest number of years between any two fires in the record, or as observed via imagery	30 m, calculated at plot location
Available water holding capacity (AWCL)	The amount of available water in the soil that can be absorbed by a plant (Shirazi et al. 2001)	1 km, inches of water available in soil profile
Elevation	U.S. Geological Survey digital elevation model	30 m
Slope	Derived from elevation	30 m
Topographic heterogeneity	Range of elevation values within 270-m radius of center cell	90 m, index from 0 to 1
Actual evapotranspiration	Total annual water evaporated from surface and transpired by plants, assuming unlimited water	270 m, mm summed annually and averaged from 1980 to 2010
Distance to all roads	TIGER line, Exclude 4WD and OHV roads; Combine others, including RRs. TIGER Roads 2015, U.S. Department of Commerce, U.S. Census Bureau	Euclidean distance, 30 m
Structure density	Spatial interpolation of digitized points at 1-km radius (Syphard et al. 2013*a*, *b*), including structures up to 2015	30 m
Distance to Wildland–Urban Interface (WUI)	Euclidean distance to interface or intermix WUI in 2010 (Radeloff et al. 2018)	30 m

the California Basin Characterization Model (Table 1). AET is derived from modeled calculations based on topography, soil, precipitation, and temperature, and we used the 30-yr baseline statistical summaries averaged from annual data from 1981 to 2010 at 270-m resolution. In addition to AWCL and AET, we again considered the potential effect of nitrogen deposition to moderate soil fertility using a 2002 map representing total annual deposition of reduced and oxidized nitrogen (kilograms of nitrogen per hectare per year) at 4-km resolution (Tonnesen et al. 2007).

As with soil and water balance data, topographic variables affect energy and moisture balance, in addition to fire behavior, and are often important indirect determinants of plant species' distributions (Franklin 1995). We explored the same three topographic variables that we used previously, including slope, elevation, and topographic heterogeneity (Table 1).

To evaluate the effect of fire frequency on vegetation change, we overlaid the Cal Fire perimeter data, which included fires from 1898 to 2016, on all plots and summed the number of times each plot had burned. In addition, we calculated the interval in years among all the fires that had occurred on each plot to obtain a minimum interval between fires. For those plots in which no fires occurred, we estimated the minimum interval to be the length of time in the fire record, which would be 118 yr. For plots that only burned once, we assessed the minimum to be either the smallest number between the 2016 and the fire date or between the fire date and the beginning of the fire record. For fires burning more than once, we calculated the number of years between all fires and between the earliest and latest fires with the beginning and end of the record, then took the minimum of those numbers.

Whereas public lands and parks extend across vast swaths of the Santa Monica Mountains, the

San Diego County study area has more extensively dispersed areas of privately owned lands with low–medium density development and Wildland–Urban Interface (WUI; Radeloff et al. 2018). Therefore, instead of evaluating distance to trails, which cover much of the Santa Monica Mountains but only a fraction of San Diego County, we considered two variables relating to human development, including structure density and distance to the Wildland–Urban Interface (WUI). The structure density map was derived via a simple density interpolation, with a 1-km search radius at 30-m resolution, of digitized point locations representing all structures in the study area, as in Syphard et al. (2013*a*) but with structures digitized through 2015. The WUI is defined as the area where development meets (interface) or intermingles with (intermix) undeveloped wildland vegetation; it is where fires are most likely to start and destroy structures (Radeloff et al. 2018) and is associated with a range of other human–natural conflicts and disturbances (Bar-Massada et al. 2014). To evaluate the potential influence of the WUI on landscape disturbance that could facilitate vegetation type conversion, we used the WUI data available via Radeloff et al. (2018) for 2010, collapsing the two classes of WUI into one and deriving the Euclidean distance to these areas at 30-m resolution. We also evaluated the Euclidean distance to roads at 30 m, using the 2015 Topographically Integrated Geographic Encoding and Referencing System TIGER/Line files from the U.S. Census 2010.

Statistical analysis of type conversion drivers

We used two types of statistical analysis to identify the most important landscape drivers of chaparral conversion and decline. The first quantified the relative independent importance of all 11 explanatory variables using the hier.part package in RStudio version 1.1.463 (MacNally and Walsh 2004, RStudio Team 2015). This approach was used to understand and compare the isolated effect of each variable on vegetation change, regardless of other variables' effect. Given our two binary dependent variables, we parameterized the statistical modeling algorithm to use a binomial response for each and to iteratively calculate the log likelihood goodness of fit for a hierarchy of regression models on all combinations of explanatory variables, thereby measuring all variables' independent effect.

To account for variable interactions and thresholds, we created multivariate classification tree models (Breiman et al. 1984). Classification trees are a nonparametric, unsupervised clustering approach that iteratively splits explanatory variable data into increasingly homogenous clusters that best differentiate between the two classes of the binomial response variable. The tree is structured so that the most influential variable is at the top, with the data falling into two classes that are split according to the critical threshold that best divides them. The tree continues to branch out with similar thresholds and splits, with the most important variables at the top and the least important at the bottom. We created trees for both binary response variables, considering all explanatory variables, using the rpart and rpart.plot packages in RStudio 1.1.463 (RStudio Team 2015). To assess model fit, we calculated the area under the curve (AUC) for receiver operating characteristic (ROC) plots (Hanley and McNeil 1982).

Results

Overall, most plots experienced substantial woody cover decline, as illustrated by the distribution of 1953 and 2016 plots across cover classes, both when divided into equal intervals (Fig. 2a) and when pure woody and grass were separated out (Fig. 2b). Fewer than half of the plots remained the same over time (307 of 661, or 46%), but there were some plots that gained woody cover during the study period (11% overall), with 58 plots gaining 25% woody cover, 16 plots gaining 50% woody cover, and one plot increasing cover by 75%. Most of these cover gains were located on the eastern portion of the study area (Fig. 1). Calculations of net cover change showed substantially larger woody cover decline than increase (Fig. 3).

Of the 661 plots that were not developed or disturbed in 1953, nor had experienced a burn within five years of either image date, 51 (8%) became partially to completely developed (i.e., paved or with a structure on it), and an additional 116 (18%) experienced some type of human disturbance by 2016. Although specific disturbance types were difficult to classify,

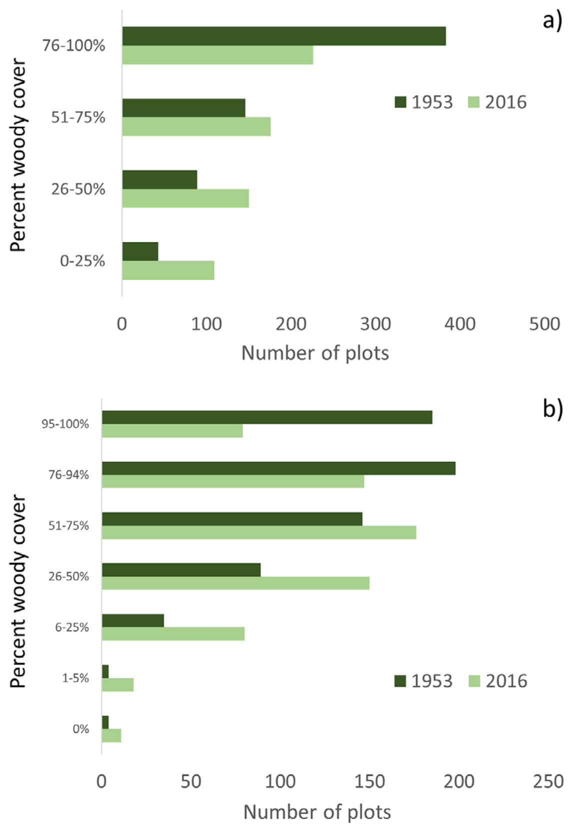

Fig. 2. Number of vegetation plots in San Diego County distributed within woody cover classes in 1953 and 2016, with (a) equal interval classification and (b) a classification that separates pure woody (95–110%) and pure herbaceous (0–5%) classes.

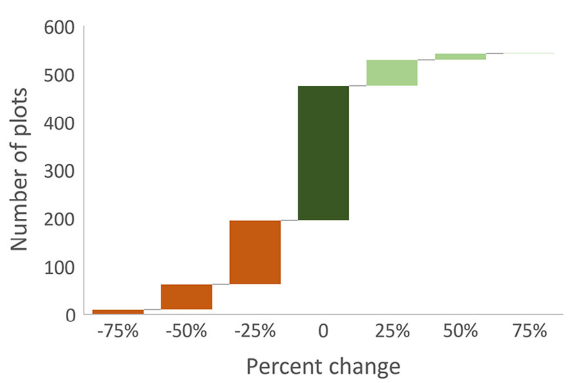

Fig. 3. Direction and amount of change among woody cover classes from 1953 to 2016 in San Diego County.

approximately 40% had become either a dirt road, fuel break, or trail; approximately 35% was some type of agriculture, orchard, nursery, or cultivated land use; approximately 20% had been cleared, potentially for fire management or new development; and the remaining 5% included miscellaneous uses, including reservoirs, planting with shade trees, mining, or ball park. Of the 311 plots that had more than 75% woody cover in 1953, 185 (59%) experienced woody cover decline, with a mean loss of 22.5% cover. Of these, 51 (28%) fully type-converted (more than 50% woody cover loss to herbaceous).

Most of the factors that had the highest percent independent contribution to chaparral conversion were the same as those with the highest contribution to chaparral decline, with slight changes in variable rankings (Fig. 4). The top drivers for both included minimum fire interval and total number of fires, actual evapotranspiration, and elevation, although there was some variation depending on whether the response was chaparral conversion or decline. The human land use variables were not strong independent contributors to either chaparral conversion or decline.

The classification trees (Fig. 5a, b) were also similar for chaparral conversion and decline. In both, the most important variable distinguishing whether a plot converted or declined was minimum fire interval, both with a threshold of 15 yr. For chaparral conversion, there were no other splits in the group with longer fire intervals; but for chaparral decline, the plots with longer intervals were next best separated by slope (steep slopes more likely to convert), then AET (low AET most likely to convert). Where there was not a minimum 15-yr interval between fires, the next most important factor was AET for both trees, with less important factors being high nitrogen deposition and close proximity to the WUI. The training AUC for the classification tree of chaparral conversion was 0.82 and for chaparral decline was 0.84.

Discussion

Despite growing recognition that chaparral type conversion is one of the Southern California's most serious ecological issues, no studies until now have provided empirical evidence for

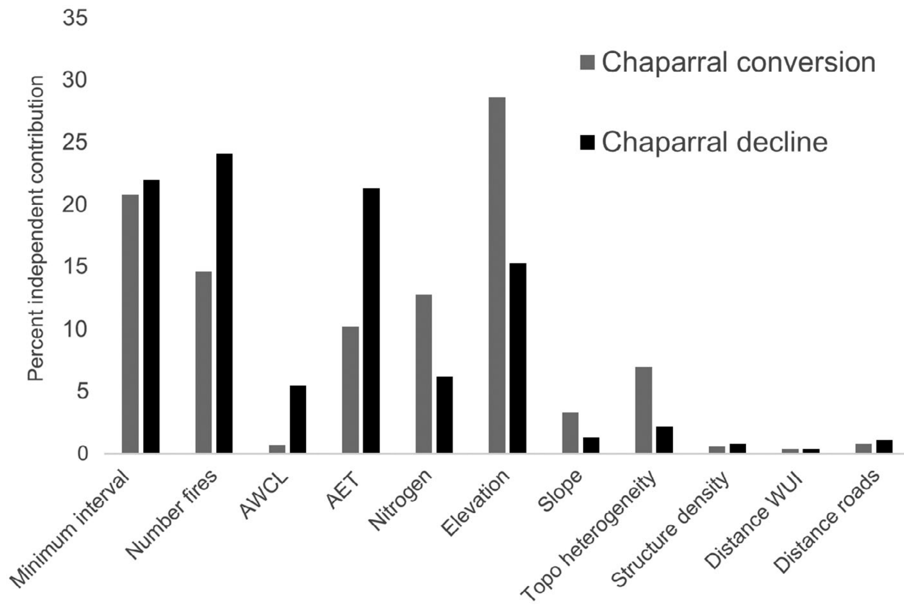

Fig. 4. Hierarchical partitioning results showing percent independent contribution of variables explaining chaparral decline and conversion to herbaceous cover from 1953 to 2016 in San Diego County, California, USA.

the extent and amount of landscape-scale woody vegetation decline and conversion into herbaceous cover. Although some studies have provided indirect evidence for extensive type conversion (Park et al. 2018, Syphard et al. 2019), there has also been debate over the feasibility of widespread change, particularly as driven by short-interval fire (Meng et al. 2014). Here, we used a random sampling approach to assess the extent of woody cover decline over a period of 53 yr in San Diego County and found strong evidence for widespread shifts in vegetation type dominance by 2016. Regardless of the initial amount of woody cover in the plots in 1953, the trajectory was consistently negative, with few plots having increased in cover in the same period. Given this substantial decline, only 16% of the initial plots that were almost entirely woody fully type-converted, highlighting that vegetation type change is a gradual process that cannot be fully captured, and in fact is underestimated, by classing vegetation into only two states.

The process of chaparral type conversion likely begins via landscape simplification, whereas a cycle of repeated short-interval fires begins, and with each subsequent fire, some chaparral species are extirpated until woody dominance is lost (Zedler 1995). In some parts of the landscape, there may even be an initial transition to drought-deciduous coastal sage scrub that tends to be more resilient to short-interval fires and more widely dispersed than chaparral (Westman and O'Leary 1986, Syphard et al. 2006). It is possible that as woody chaparral degraded in this study, that some transitioned to sage scrub. If this would have happened, it would have been difficult to discern the type change if the percentage of woody cover remained the same. However, given that sage scrub is often more open than chaparral, that would have been accounted for in the calculations of woody cover change. Most of the earlier field studies on fire-driven chaparral conversion to herbaceous vegetation focused on different sensitivities of post-fire functional groups (e.g., Zedler et al. 1983, Haidinger and Keeley 1993, Jacobsen et al. 2004, Keeley and Brennan 2012) with consistent evidence that different species require different amounts of time before seed and bud banks can regenerate sufficiently to repopulate a stand. Although we could not distinguish species composition from air photographs, it makes sense that the rate of woody decline

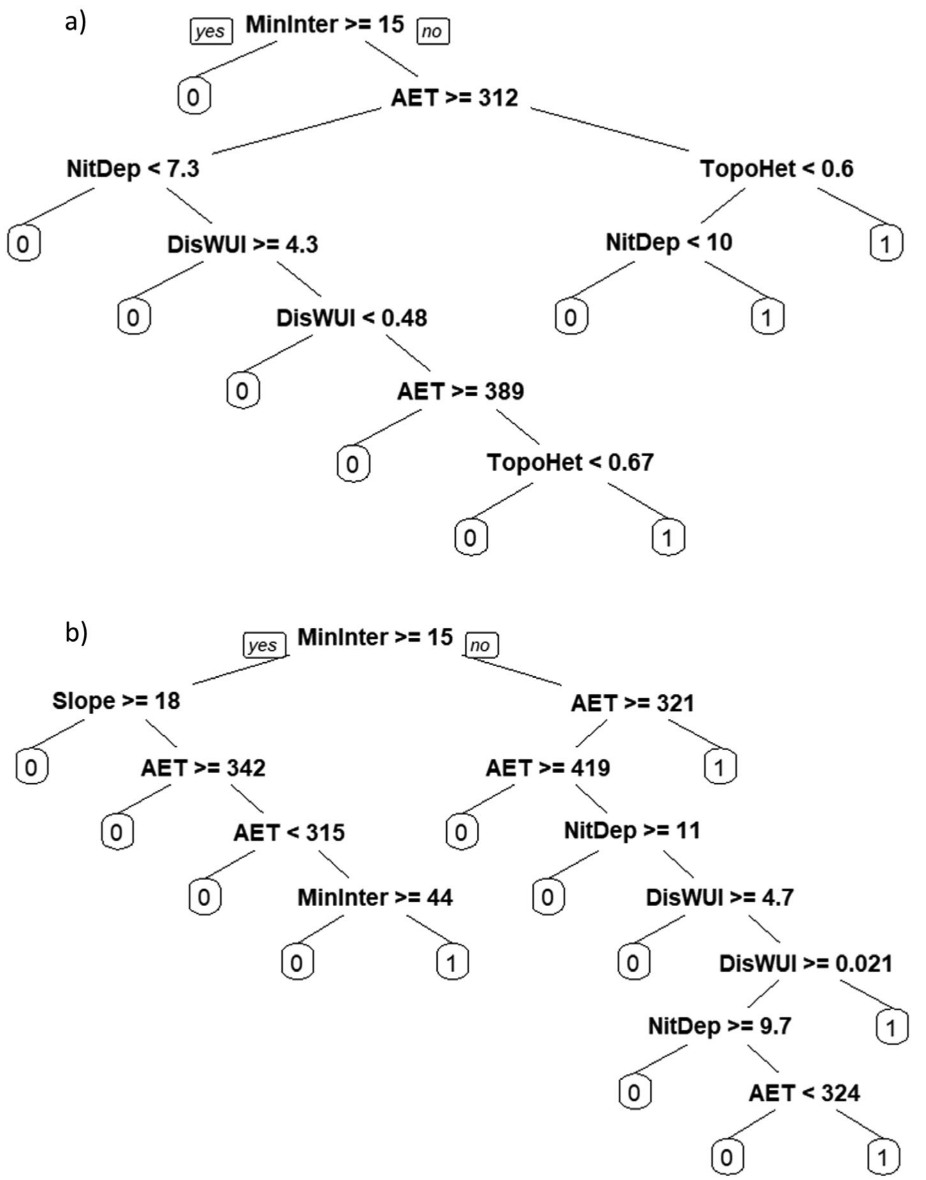

Fig. 5. Classification tree plots showing relationships among variables explaining (a) chaparral conversion and (b) chaparral decline from 1953 to 2016 in San Diego County.

may vary across the landscape depending on species' distributions and other environmental factors, many of which we explored here.

The role of fire was the most important factor distinguishing plots where woody vegetation converted to herbaceous or declined. This result is not surprising, as it is consistent with field studies and the results from the similar study in the Santa Monica Mountains (2019), and it thus underlines the primary role of fire in chaparral degradation and decline. As with Jacobsen et al. (2004) and Syphard et al. (2019), the primary mechanism here was minimum fire interval, more than total fire frequency. However, the threshold that best distinguished converted or declining plots was a minimum of 15 yr, whereas it was 10 yr in the Santa Monica Mountains. This longer interval, or threshold, suggests that either species composition in the plots sampled here consists of more fire-sensitive species, such as obligate or facultative seeders (as was shown in Lippitt et al. 2012); or there are certain environmental conditions here that contribute to longer times needed for chaparral post-fire regeneration.

Both in the Santa Monica Mountains (via AWCL) and here in San Diego County (via AET), the parts of the landscape most susceptible to drought or low soil moisture availability were also more likely to experience woody conversion or decline, which was also the case in Park et al. (2018). Extreme drought conditions have been shown to increase post-fire mortality of resprouts or seedlings, in addition to adult shrub mortality (Paddock et al. 2013, Ventura et al. 2016, Jacobsen and Pratt 2018), which could provide a competitive advantage to exotic annuals in the post-fire environment. Given that many of the plots in San Diego County do not receive the moisturizing benefits of coastal fog and that San Diego County is generally warmer and drier than the Santa Monica Mountains, this may explain why chaparral overall takes longer to recover here.

The important point here is that drought is of greatest importance in the post-fire environment, and thus, there could be serious implications if droughts were to increase under climate change. Drought interacts with fire to reduce post-fire recovery (Pratt et al. 2014), and when fires are frequent under drought conditions, this can exacerbate the invasion of non-native grasses. Certainly, one of the factors involved here is that the shrub life histories susceptible to short fire-return intervals are the obligate seeding mode, and obligate seeding species are most abundant on drier slopes (Keeley and Syphard 2018*b*); these are also the species must vulnerable physiologically to drought (Ventura et al. 2016), and thus, the association between type conversion and more arid sites is also related to functional type distribution.

There are other landscape differences between the Santa Monica Mountains and San Diego County that may explain other differences in environmental variable importance. For instance, there is a greater elevational gradient in San Diego County, which may be why elevation was more important here than topographic heterogeneity, at least when explored independently (both slope and topographic heterogeneity were important in the trees that accounted for variable interactions). Both elevation and other terrain measures are correlated with many variables that mediate plant species physiological tolerances and distribution, from climate to soil, in addition to proximity to human disturbance (Franklin 1995, Syphard et al. 2013*b*). Therefore, it is difficult to untangle the mechanism underlying this association.

Surprisingly, although there are more expansive residential development and WUI in San Diego County than in the Santa Monica Mountains, anthropogenic variables were among the lowest in percentage independent contribution, although nitrogen deposition was more important here than in the Santa Monica Mountains, perhaps due to a longer gradient inland from urban to rural. Proximity to WUI was retained as significant in the classification trees, but the variable was low on the tree and therefore not highly influential. Although proximity to development was not highly significant, there was nevertheless a substantial amount of vegetation conversion due to development (8%) or disturbance (18%), and the continuation of direct habitat loss will clearly exacerbate other fire- or disturbance-driven unintentional vegetation change.

Conclusion

This assessment of chaparral decline and replacement indicates that vegetation change is occurring extensively and rapidly in Southern California. This has serious implications for ecological and human communities, as chaparral provides critically important ecological services in the region (Underwood et al. 2018), which are not provided by exotic annual grasses and forbs. Southern California, and chaparral itself, has incredibly high biodiversity (Myers et al. 2000), with most characteristic bird, mammal, and insect communities aligning with shrub cover. Thus, the loss of chaparral is an ecological impact of global significance (Cowling et al. 1996). Further, given strong convergence in ecosystem function and structure across the world's Mediterranean regions, ongoing conversion of woody cover to herbaceous vegetation in Southern California could represent a harbinger of things to come for other regions, which are also biodiversity hotspots. In fact, increased fire frequency and feedbacks with exotic grass are already a concern in all five Mediterranean regions (Vilà et al. 2001, Pignatti et al. 2002, Milton 2004, Syphard et al. 2009). Unfortunately, due to short dispersal distances and low recruitment between fires for most chaparral and many other Mediterranean shrubland species (Keeley et al. 1989), once a stand has converted to herbaceous vegetation, reversal of this change is difficult.

Conversion of chaparral to exotic herbaceous cover may also increase wildfire risk to humans, and may lead to a perpetuating positive feedback cycle, frequently referred to as the grass–fire cycle (D'Antonio and Vitousek 1992). Positive feedbacks can occur because annual grasses and forbs are highly resilient to frequent fire, are very flammable, and typically burn in low-intensity fires that favor their persistence and a cycle of repeating fires (Keeley et al. 2012). With unprecedented recent large fires having occurred across Southern California, there are huge expanses of vulnerable young vegetation that are at risk of burning again before the minimum of at least 10–15 yr needed for chaparral recovery. Prevention and planning to reduce fire ignitions and exposure of human communities to flammable wildland, especially in these fire-saturated parts of the landscape, will be key to sustaining the future of chaparral in the region.

Acknowledgments

Any use of trade, product, or firm names is for descriptive purposes only and does not imply endorsement by the US government.

Literature Cited

Bar-Massada, A., V. C. Radeloff, and S. I. Stewart. 2014. Biotic and abiotic effects of human settlements in the wildland-urban interface. BioScience 64:429–437.

Breiman, L., J. Friedman, R. Olshen, and C. Stone. 1984. Classification and regression trees. Wadsworth, Belmont, California, USA.

Burcham, L. T. 1955. Recent trends in range improvement on California foothill ranges. Journal of Range Management 8:121–125.

Cooper, W. S. 1922. The broad-sclerophyll vegetation of California. An ecological study of the chaparral and its related communities. Carnegie Institution of Washington, Washington, D.C., USA.

Cowling, R. M., P. W. Rundel, B. B. Lamont, and M. T. K. Arroyo. 1996. Plant diversity in Mediterranean-climate regions. Trends in Ecology and Evolution 11:1035–1046.

Cox, R. D., K. L. Preston, R. F. Johnson, R. A. Minnich, and E. B. Allen. 2014. Influence of landscape-scale variables on vegetation conversion to exotic annual grassland in southern California, USA. Global Ecology and Conservation 2:190–203.

D'Antonio, C. M., and P. M. Vitousek. 1992. Biological invasions by exotic grasses, the grass/fire cycle, and global change. Annual Review of Ecology and Systematics 23:63–87.

Davis, K. T., S. Z. Dobrowski, P. E. Higuera, Z. A. Holden, T. T. Veblen, M. T. Rother, S. A. Parks, A. Sala, and M. P. Maneta. 2019. Wildfires and climate change push low-elevation forests across a critical climate threshold for tree regeneration. Proceedings of the National Academy of Sciences 116:6193–6198.

Dobson, A. P., J. P. Rodriguez, W. M. Roberts, and D. S. Wilcove. 1997. Geographic distribution of endangered species in the United States. Science 275:550–553.

Fenn, M., et al. 2010. Nitrogen critical loads and management alternatives for N-impacted ecosystems in California. Journal of Environmental Management 91:2404–2423.

Flint, A. L., and L. E. Flint. 2012. Downscaling future climate scenarios to fine scales for hydrologic and ecologic modeling and analysis. Ecological Processes 1:2.

Franklin, J. 1995. Predictive vegetation mapping: geographic modeling of biospatial patterns in relation to environmental gradients. Progress in Physical Geography 19:474–499.

Franklin, J., H. M. Regan, and A. D. Syphard. 2014. Linking spatially explicit species distribution and population models to plan for the persistence of plant species under global change. Environmental Conservation 41:97–109.

Haidinger, T. L., and J. E. Keeley. 1993. Role of high fire frequency in destruction of mixed chaparral. Madroño 40:141–147.

Hanley, J. A., and B. J. McNeil. 1982. The meaning and use of the area under a receiver operating characteristics curve. Radiology 143:29–36.

Jacobsen, A. L., S. D. Davis, and S. L. Fabritius. 2004. Fire frequency impacts non-sprouting chaparral shrubs in the Santa Monica Mountains of southern California. Ecology, conservation and management of Mediterranean climate ecosystems. MillPress, Rotterdam, The Netherlands.

Jacobsen, A. L., and R. B. Pratt. 2018. Extensive drought-associated plant mortality as an agent of type-conversion in chaparral shrublands. New Phytologist 219:498–504.

Jin, Y., M. Goulden, S. Faivre, V. Veraverbeke, A. Hall, M. Hand, S. Hook, and J. Randerson. 2015. Identification of two distinct fire regimes in southern California: implications for economic impact and future change. Environmental Research Letters 10:094005.

Keeley, J. E. 2005. Fire as a threat to biodiversity in fire-type shrublands. Proceedings of the Conference, Planning for Biodiversity: Bringing Research and Management Together. USDA Forest Service, Pacific Southwest Research Station, General Technical Report PSW-GTR-195.

Keeley, J. E., W. J. Bond, R. A. Bradstock, J. G. Pausas, and P. W. Rundel. 2012. Fire in Mediterranean ecosystems ecology, evolution and management. Cambridge University Press, Cambridge, UK.

Keeley, J. E., and T. J. Brennan. 2012. Fire-driven alien invasion in a fire-adapted ecosystem. Oecologia 169:1043–1052.

Keeley, J. E., and C. J. Fotheringham. 2003. Impact of past, present, and future fire regimes on North American Mediterranean shrublands. Pages 218–262 *in* T. T. Veblen, W. L. Baker, G. Montenegro, and T. W. Swetnam, editors. Fire and climate change in temperate ecosystems of the western Americas. Springer, New York, New York, USA.

Keeley, J. E., and A. D. Syphard. 2018*a*. South coast bioregion. Pages 319–351 *in* J. W. van Wagtendonk, N. G. Sugihara, S. L. Stephens, A. Thode, K. Shaffer, and A. Fites-Kaufman, editors. Fire in California's ecosystems. Second edition. University of California Press, Davis, California, USA.

Keeley, J. E., and A. D. Syphard. 2018*b*. Historical patterns of wildfire ignition sources in California ecosystems. International Journal of Wildland Fire 27:781–799.

Keeley, J. E., P. H. Zedler, C. A. Zammit, and T. J. Stohlgren. 1989. Fire and demography. Pages 151–153 *in* S. C. Keeley, editor. The California chaparral: paradigms reexamined. Natural History Museum of Los Angeles County, Los Angeles, California, USA.

Kelly, M., B. Allen-Diaz, and N. Kobzina. 2005. Digitization of a historic dataset: the Wieslander California vegetation type mapping project. Madroño 52:191–201.

Lippitt, C. L., D. A. Stow, J. F. O'Leary, and J. Franklin. 2012. Influence of short-interval fire occurrence on post-fire recovery of fire-prone shrublands in California, USA. International Journal of Wildland Fire 22:184–193.

MacNally, R., and C. J. Walsh. 2004. Hierarchical partitioning public-domain software. Biodiversity and Conservation 13:659–660.

Meng, R., P. E. Dennison, C. M. D'Antonio, and M. A. Moritz. 2014. Remote sensing analysis of vegetation recovery following short-interval fires in southern California shrublands. PLoS ONE 9: e110637.

Miles, S. R., and C. B. Goudey. 1997. Ecological subregions of California: section and subsection descriptions. R5-EM-TP-005. USDA Forest Service, Pacific Southwest Region, San Francisco, California, USA.

Milton, S. J. 2004. Grasses as invasive alien plants in South Africa: working for water. South African Journal of Science 100:69–75.

Minnich, R. A., and R. J. Dezzani. 1998. Historical decline of coastal sage scrub in the Riverside-Perris Plain, California. Western Birds 29:366–391.

Myers, N., R. A. Mittermeier, C. G. Mittermeier, G. A. B. Da Fonseca, and J. Kent. 2000. Biodiversity hotspots for conservation priorities. Nature 403:853–858.

Paddock III, W. A. S., S. D. Davis, R. B. Pratt, A. L. Jacobsen, M. F. Tobin, J. López-Portillo, and F. W. Ewers. 2013. Factors determining mortality of adult chaparral shrubs in an extreme drought year in California. Aliso: A Journal of Systematic and Evolutionary Botany 31:49–57.

Park, I. W., J. Hooper, J. M. Flegal, and G. D. Jenerette. 2018. Impacts of climate, disturbance and topography on distribution of herbaceous cover in Southern California chaparral: insights from a remote-sensing method. Diversity and Distributions 24:497–508.

Pausas, J. G. 2015. Alternative fire-driven vegetation states. Journal of Vegetation Science 26:4–6.

Pignatti, E., S. Pignatti, and P. G. Ladd. 2002. Comparison of ecosystems in the Mediterranean Basin and Western Australia. Plant Ecology 163:177–186.

Pratt, R. B., A. L. Jacobsen, A. R. Ramirez, A. M. Helms, C. A. Traugh, M. F. Tobin, M. S. Heffner, and S. D. Davis. 2014. Mortality of resprouting chaparral shrubs after a fire and during a record drought: physiological mechanisms and demographic consequences. Global Change Biology 20:893–907.

Radeloff, V. C., et al. 2018. Rapid growth of the US wildland-urban interface raises wildfire risk. Proceedings of the National Academy of Sciences of the United States of America 115:3314–3319.

RStudio Team. 2015. RStudio: integrated development for R. RStudio, Boston, Massachusetts, USA.

Rundel, P. W. 2018. California chaparral and its global significance. Pages 1–27 *in* E. C. Underwood, H. D. Safford, N. A. Molinari, and J. E. Keeley, editors. Valuing chaparral. Springer, New York, New York, USA.

Russell, W. H., and J. R. McBride. 2003. Landscape scale vegetation-type conversion and fire hazard in the San Francisco bay area open spaces. Landscape and Urban Planning 64:201–208.

Safford, H., and K. Van de Water. 2014. Using fire return interval departure (FRID) analysis to map spatial and temporal changes in fire frequency on national forest lands in California.

Shirazi, M. A., L. Boersma, P. K. Haggerty, and C. B. Johnson. 2001. Spatial extrapolation of soil characteristics using whole-soil particle size distributions. Journal of Environmental Quality 30:101–111.

Syphard, A. D., A. Bar Massada, V. Butsic, and J. E. Keeley. 2013*a*. Land use planning and wildfire: Development policies influence future probability of housing loss. PLoS ONE 8:e71708.

Syphard, A. D., H. M. Regan, J. Franklin, R. M. Swab, and T. C. Bonebrake. 2013*b*. Does functional type vulnerability to multiple threats depend on spatial context in Mediterranean-climate regions? Diversity and Distributions 19:1263–1274.

Syphard, A. D., T. J. Brennan, and J. E. Keeley. 2018. Chaparral landscape conversion in Southern California. Pages 323–341 *in* E. C. Underwood, H. D. Safford, N. A. Molinari, and J. E. Keeley, editors. The ecological value of chaparral landscapes: ecosystem services and resource management. Springer, New York, New York, USA.

Syphard, A. D., T. J. Brennan, and J. E. Keeley. 2019. Drivers of chaparral type conversion to herbaceous vegetation in coastal Southern California. Diversity and Distributions 25:90–101.

Syphard, A. D., J. Franklin, and J. E. Keeley. 2006. Simulating the effects of frequent fire on southern California coastal shrublands. Ecological Applications 16:1744–1756.

Syphard, A. D., V. C. Radeloff, T. J. Hawbaker, and S. I. Stewart. 2009. Conservation threats due to human-caused increases in fire frequency in Mediterranean-climate ecosystems. Conservation Biology 23:758–769.

Talluto, M., and K. Suding. 2008. Historical change in coastal sage scrub in southern California, USA in relation to fire frequency and air pollution. Landscape Ecology 23:803–815.

Tonnesen, G., Z. Wang, M. Omary, and C. Chien. 2007. Assessment of nitrogen deposition: modeling and habitat assessment. California Energy Commission, PIER Energy-Related, Sacramento, California, USA.

Turner, M. G., K. H. Braziunas, W. D. Hansen, and B. J. Harvey. 2019. Short-interval severe fire erodes the resilience of subalpine lodgepole pine forests. Proceedings of the National Academy of Sciences: 201902841.

Underwood, E. C., A. D. Hollander, P. R. Huber, and C. Schrader-Patton. 2018. Mapping the value of national forest landscapes for ecosystem service provision. Pages 245–270 *in* E. C. Underwood, H. D. Safford, N. A. Molinari, and J. E. Keeley, editors. Valuing chaparral. Springer, New York, New York, USA.

Ventura, M., E. MacKinnon, H. Dario, A. Jacobsen, R. Pratt, and S. Davis. 2016. Chaparral shrub hydraulic traits, size, and life history types relate to species mortality during California's historic drought of 2014. PLoS ONE 11:e0159145.

Vilà, M., F. Lloret, E. Ogheri, and J. Terradas. 2001. Positive fire–grass feedback in Mediterranean Basin woodlands. Forest Ecology and Management 147:3–14.

Westman, W. E., and J. F. O'Leary. 1986. Measures of resilience: the response of coastal scrub to fire. Vegetatio 65:179–189.

Zedler, P. H. 1995. Fire frequency in southern California shrublands: biological effects and management options. Pages 101–112 *in* J. E. Keeley and T. Scott, editors. Brushfires in California wildlands: ecology and resource management. International Association of Wildland Fire, Missoula, Montana, USA.

Zedler, P. H., C. R. Gautier, and G. S. McMaster. 1983. Vegetation change in response to extreme events: the effect of a short interval between fires in California chaparral and coastal scrub. Ecology 64:809–818.

COUNTY OF LOS ANGELES
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September 3, 2019

Edith Hannigan, Program Manager
California Board of Forestry and Fire Protection
Land Use Planning Program
P.O. Box 944246
Sacramento, CA 94244

Dear Ms. Hannigan:

NOTICE OF AVAILABILITY OF A PROGRAM ENVIRONMENTAL IMPACT REPORT, "CALIFORNIA VEGETATION TREATMENT PROGRAM," WOULD IMPLEMENT VEGETATION TREATMENTS TO REDUCE WILDFIRE RISKS AND AVOID OR DIMINISH THE HARMFUL EFFECTS OF WILDFIRE ON THE PEOPLE, PROPERTY, AND NATURAL RESOURCES IN THE STATE OF CALIFORNIA, STATEWIDE, FFER 201900058

The Notice of Availability of a Program Environmental Impact Report has been reviewed by the Planning Division, Land Development Unit, Forestry Division, and Health Hazardous Materials Division of the County of Los Angeles Fire Department.

The following are their comments:

PLANNING DIVISION:

We have no comments.

For any questions regarding this response, please contact Loretta Bagwell, Planning Analyst, at (323) 881-2404 or Loretta.Bagwell@fire.lacounty.gov.

LAND DEVELOPMENT UNIT:

1. The proposed development may necessitate multiple ingress/egress access for the circulation of traffic and emergency response issues.

2. The development of this project must comply with all applicable code and ordinance requirements for construction, access, water mains, fire flows, and fire hydrants.

3. Specific fire and life safety requirements for the construction phase will be addressed at the building fire plan check. There may be additional fire and life safety requirements during this time.

4. Every building constructed shall be accessible to Fire Department apparatus by way of access roadways with an all-weather surface of not less than the prescribed width. The roadway shall be extended to within 150 feet of all portions of the exterior walls when measured by an unobstructed route around the exterior of the building.

5. Fire Department requirements for access, fire flows, and hydrants are addressed during the building permit stage.

6. Fire hydrant spacing shall be 300 feet and shall meet the following requirements:

   a) No portion of lot frontage shall be more than 200 feet via vehicular access from a public fire hydrant.

   b) No portion of a building shall exceed 400 feet via vehicular access from a properly spaced public fire hydrant.

   c) Additional hydrants will be required if hydrant spacing exceeds specified distances.

   d) When cul-de-sac depth exceeds 200 feet on a commercial street, hydrants shall be required at the corner and mid-block.

   e) A cul-de-sac shall not be more than 500 feet in-length when serving land zoned for commercial use.

7. The development may require fire flows up to 8,000 gallons per minute at 20 pounds per square inch residual pressure for up to a four-hour duration. Final fire flows will be based on the size of buildings, its relationship to other structures, property lines, and types of construction used.

8. Turning radii shall not be less than 32 feet. This measurement shall be determined at the centerline of the road. A Fire Department approved turning area shall be provided for all driveways exceeding 150 feet in-length and at the end of all cul-de-sacs.

9. All on-site driveways/roadways shall provide a minimum unobstructed width of 28 feet, clear-to-sky for structures greater than 30' in height. The on-site driveway is to be within 150 feet of all portions of the exterior walls of the first story of any building. The

centerline of the access driveway shall be located parallel to and within 30 feet of an exterior wall on one side of the proposed structure.

10. Driveway width for non-residential developments shall be increased when any of the following conditions will exist:

    a) Provide 34 feet in-width, when parallel parking is allowed on one side of the access roadway/driveway. Preference is that such parking is not adjacent to the structure.

    b) Provide 42 feet in-width when parallel parking is allowed on each side of the access roadway/driveway.

    c) Any access way less than 34 feet in-width shall be labeled "Fire Lane" on the final recording map and final building plans.

    d) For streets or driveways with parking restrictions: The entrance to the street/driveway and intermittent spacing distances of 150 feet shall be posted with Fire Department approved signs stating "NO PARKING - FIRE LANE" in three-inch high letters. Driveway labeling is necessary to ensure access for Fire Department use.

11. Fire hydrant spacing shall be 600 feet and shall meet the following requirements:

    a) No portion of lot frontage shall be more than 450 feet via vehicular access from a public fire hydrant.

    b) No portion of a structure should be placed on a lot where it exceeds 750 feet via vehicular access from a properly spaced public fire hydrant.

    c) When cul-de-sac depth exceeds 450 feet on a residential street, hydrants shall be required at the corner and mid-block.

    d) Additional hydrants will be required if hydrant spacing exceeds specified distances.

12. All access devices and gates shall comply with California Code of Regulations, Title 19, Articles 3.05 and 3.16.

13. Disruptions to water service shall be coordinated with the County of Los Angeles Fire Department and alternate water sources shall be provided for fire protection during such disruptions.

The County of Los Angeles Fire Department's Land Development Unit appreciates the opportunity to comment on this project.

For any questions regarding the report, please contact Joseph Youman at (323) 890-4243 or Joseph.Youman@fire.lacounty.gov.

FORESTRY DIVISION – OTHER ENVIRONMENTAL CONCERNS:

The statutory responsibilities of the County of Los Angeles Fire Department's Forestry Division include erosion control, watershed management, rare and endangered species, vegetation, fuel modification for Very High Fire Hazard Severity Zones, archeological and cultural resources, and the County Oak Tree Ordinance. Potential impacts in these areas should be addressed.

Under the Los Angeles County Oak tree Ordinance, a permit is required to cut, destroy, remove, relocate, inflict damage or encroach into the protected zone of any tree of the Oak genus which is 25 inches or more in circumference (eight inches in diameter), as measured 4 1/2 feet above mean natural grade.

If Oak trees are known to exist in the proposed project area further field studies should be conducted to determine the presence of this species on the project site.

The County of Los Angeles Fire Department's Forestry Division has no further comments regarding this project.

For any questions regarding this response, please contact Forestry Assistant, Joseph Brunet at (818) 890-5719.

HEALTH HAZARDOUS MATERIALS DIVISION:

The Health Hazardous Materials Division of the Los Angeles County Fire Department has no comments or requirements for the project at this time.

Please contact HHMD senior typist-clerk, Perla Garcia at (323) 890-4035 or Perla.garcia@fire.lacounty.gov if you have any questions.

If you have any additional questions, please contact this office at (323) 890-4330.

Very truly yours,

Michael Y. Takeshita

MICHAEL Y. TAKESHITA, ACTING CHIEF, FORESTRY DIVISION
PREVENTION SERVICES BUREAU

MYT:ac