Evaluating the Impact of Native Vegetation Disturbance on Fire Risk in San Diego County

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Introduction

Increasing fire frequency in San Diego County has a negative impact on native plant communities, properties, and infrastructure; particularly those in the Wildland/Urban Interface (WUI) (Keeley 2009; Keeley 2019; Nagy 2018; Syphard 2006). This poses a growing concern for the protection of these places from an ecological, practical, and economic perspective.

To mitigate the losses of buildings, the County of San Diego developed a Defensible Space ordinance (County of San Diego ORDINANCE NO. 10147, 2011) requiring the removal of combustible material, which can include native vegetation, in a 100-foot radius from any structure. The intention of this ordinance is to reduce fire risk; however, the efficacy of removing native vegetation to reduce fire risk has not been determined. There is a substantial body of literature examining the relationship between fire and the chaparral and coastal sage scrub (CSS) habitats of southern California. We reviewed the literature to evaluate the impact of native vegetation disturbance on fire risk in San Diego County chaparral and CSS habitats.

Native habitats of San Diego County

The County of San Diego is one of the largest in the country, at 4,526 square miles (U.S. Census Bureau). It contains over 700,000 acres of chaparral and 264,000 acres of CSS (San Diego Management and Monitoring Program). These two habitats fall within the California Floristic Province Hotspot, which was dedicated as a hotspot in 1996 (Burge 2016). The chaparral and CSS region consist of numerous endemic species of plants and animals (World Wildlife Fund). The region is currently classified as endangered due to development and agriculture (World Wildlife fund).

The natural fire return intervals for chaparral and CSS in San Diego County are unclear. However, estimates support long-term fire intervals. Minnich (1983) found that the fire return interval for CSS is over 100 years in southern California by analyzing remote imagery of from 1972-1980. There is strong evidence that fire return interval was high pre-development due to the low occurrence of natural ignition fires such as lightning strikes (Keeley 1982). It has been estimated that if a stand burns within a 10-year period, type conversion may take place (O'Leary 1990a), changing the fire return interval. In the past century, fires have become yearly events, or even more frequently, leading to additional significant loss of these native habitats (Keeley 2009; Keeley 2019; Nagy 2018; Syphard 2006).

In this time, the county has undergone large-scale development into much of the region's chaparral and CSS habitat. The area where development meets undeveloped land, known as the Wildland-Urban Interface (WUI), is predominantly within these two habitat types. Currently, this is where greater than 95% of fires are ignited, predominantly due to human involvement (Keeley 2009; Syphard 2007).

Definitions

The following terms are important to define as they are used throughout the literature, related codes and ordinances, and this paper, and sometimes they have different interpretations.

- WILDFIRE is any uncontrolled fire spreading through vegetative fuels that threaten to destroy life, property, or resources as defined in Public Resources Code sections 4103 and 4104 (San Diego County Fire Authority/Fire Protection District, n.d.).

- WILDLAND-URBAN INTERFACE (WUI) FIRE AREA is a geographical area identified by the state as a "Fire Hazard Severity Zone" in accordance with the Public Resources Code sections 4201 through 4204 and Government Code sections 51175 through 51189, or other areas designated by the enforcing agency to be at a significant risk from wildfires (San Diego County Fire Authority/Fire Protection District, n.d.).

- NON-NATIVE GRASSES (NNGs) in San Diego County increase fire risk and compete for resources with native vegetation (Invasive Plants and Wildfires in Southern California, n.d.).

- COMBUSTIBLE VEGETATION means material that in its natural state will readily ignite, burn and transmit fire from native or landscape plants to any structure or other vegetation. Combustible vegetation includes dry grass, brush, weeds, litter or other flammable vegetation that creates a fire hazard (San Diego County Fire Authority/Fire Protection District, n.d.).

- DEFENSIBLE SPACE is an area either natural or man-made, where material capable of allowing a fire to spread unchecked has been treated, cleared or modified to slow the rate and intensity of an advancing wildfire and to create an area for fire suppression operations to occur. Distance measurements for defensible space shall be measured on a horizontal plane (San Diego County Fire Authority/Fire Protection District, n.d.).

Search methodology

We reviewed the existing literature to determine how removal of native vegetation affects fire risk. While our focus is San Diego County, we have also included some studies examining other parts of southern California, because the areas are in close proximity and contain many of the same species, such as San Bernardino County chaparral. We did not include studies of chaparral in other parts of the United States, nor did we include studies looking at different habitats in San Diego County.

We are focusing specifically on chaparral and CSS because they are the county's dominant habitats (San Diego Management and Monitoring Program). Most of the WUI in San Diego County is within one of these two habitat types.

We examined 25 documents in total; 22 of which are original investigations from scholarly journals accessed in online databases (EBSCOhost, JSTOR, One Search, Science Direct, Springer

Link, etc.). The other three are government documents from the County of San Diego. These studies were grouped into four subtopics which examine different elements of the impacts of native vegetation removal on fire risk. The studies relevant to each subtopic are organized in appendices.

Results

Effect of removal of native vegetation through controlled burns or unintentional fires (Appendix 1)

An increase in fire frequency correlates with an increase in NNGs or non-native herbaceous cover. Studies demonstrate that the disturbance of fire favors the succession of invasive grasses over the native vegetation (Brennan 2015; Brennan 2017; Giessow 1996; Haidinger 1993; Syphard 2006; Syphard 2019; Talluto 2008). This is due to the rapid colonization of these r-adapted species of grasses over the k-adapted natives (Rafferty 2014). Furthermore, it appears to be a non-linear relationship between fire frequency and native survival. As the frequency of fire narrows, the likelihood of native plant survival approaches zero at a quicker rate due to the importance of early establishment of the native species (O'Leary 1988). If a subsequent fire occurs within this crucial stage of development, the plants natives will experience much higher mortality rates with each subsequent fire (Talluto 2008; Zedler 1983).

Effect of removal of native vegetation through mechanical disturbance (Appendix 2)

Studies established in southern California chaparral and CSS show that mastication of shrubland sites results in the invasion of non-native grasses (Brennan 2015; Brennan 2017). In areas that have not been previously disturbed, there is a very high dominance of natives compared to non-natives. However, in disturbed sites, non-natives are dominant and were present 91% of the time (Brennan 2017).

Effect of presence of non-native grasses (NNGs) on fire risk (Appendix 3)

An increase in NNGs is shown to result in an increase in fire frequency. In San Diego County, the majority of fires start with the ignition of NNGs compared to the ignition of native shrubland (Balch 2013; Keeley 2012; Talluto 2008). NNGs ignite under a wider variety of weather conditions (Keeley 2012).The flammability properties of these grasses far exceed those of the native vegetation (Brennan 2015; Brooks 2004; Setterfield 2018; Syphard 2006).

Relationship between mature chaparral and coastal sage scrub stands and fire risk (Appendix 4)

Large, high-intensity fires are the natural fire regime for southern California chaparral and CSS, and they predate modern fire suppression policy and procedures (Keeley 2009). What has changed in the last few decades is the extreme increase in fire (Keeley 2009; Syphard 2006; Syphard 2007; Syphard 2019; Talluto 2008). The frequency of fire has led to an increase in colonization of NNGs as demonstrated above (Breanna 2015; Breanna 2017; Giessow 1996; Haidinger 1993; Syphard 2006; Syphard 2019; Talluto 2008). This indicates that mature stands do not increase fire risk and 'fuel-load' accumulation because the natural fire regime has co-evolved with the native vegetation. However, with the introduction of NNGs, 'fuel accumulation' may become a factor (Setterfield 2013) due to the increased flammability of annual NNGs that die off each year resulting in increased dry fuel. (Brooks 2004).

Conclusions

Native vegetation disturbance causes an increase in colonization with non-native grasses (NNGs), which increases fire risk. A positive feedback loop is created, amplifying fire frequency throughout the county, specifically throughout the Wildland-Urban Interface (WUI).

Further, successive disturbances within a narrow time frame relative to the natural fire return interval, lead to increased colonization of NNGs and increased loss of native vegetation. Any purposeful disturbance of a native stand of vegetation increases NNG colonization, which increases the likelihood of another fire happening sooner.

Mature stands of chaparral and CSS show no increased fire risk, and the 'fuel-load' hypothesis has not been supported in these habitat types.

Recommendations

Fire management policies in San Diego County chaparral and CSS communities would benefit from a shift in focus. It has been established that allowing for the continued colonization of NNGs not only increases fire risk but also results in a positive feedback loop. We recommend that the County adjust its Defensible Space ordinance to emphasize removal of man-made combustibles in a 100' radius, and allow native vegetation to remain. Healthy stands of mature chaparral and CSS prevent the establishment of flammable NNGs.

In order to protect properties and infrastructure, we recommend the county continue to encourage the hardening of structures against fire. This may consist of fire-retardant materials, informed city-planning to reduce fragmentation and vegetation-urban boundaries, and focusing development in urban areas rather than rural or undeveloped wildland areas.

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Appendix 2. Effect of removal of native vegetation through mechanical disturbance

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Appendix 4. Relationship between mature chaparral and coastal sage scrub stands and fire

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