Mapping fire occurrence in Greater sage-grouse habitat from 1910-2015 in northeastern California and northern Nevada

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ABSTRACT

The greater sage-grouse (*Centrocercus urophasianus*) inhabits sagebrush habitat throughout the northwestern United States. Over the past few decades, sage-grouse populations have been declining throughout its natural range prompting the United States Fish and Wildlife Service (USFWS) to consider it as a candidate species under the Threatened and Endangered Species act of 1973. The USFWS has identified the following anthropogenic and natural factors contributing to the decline in sage-grouse populations: juniper encroachment, fire, loss of sagebrush cover, mining, and invasive annual grasses. The sagebrush cover is of vital importance to greater sagegrouse, both as nesting habitat and also as a food source. However, increased fire frequencies has resulted in the widespread loss of sagebrush cover throughout the range of the greater sagegrouse. Our study quantifies the acreage burned from 1910-2015 in sage-grouse habitat in northeastern California and northern Nevada, focusing on the following counties: Elko, Eureka, Humboldt, Lander, Lassen, Modoc, Pershing, and Washoe. In order to perform the analysis, data was acquired from the following agencies: Bureau of Land Management (BLM), Cal-fire, and United States Forest Service (USFS). In addition, the following vector analysis tools: clip, select by attributes, Boolean operators (AND + OR), add field, calculate geometry, and summary statistics. We found that the number of fires occurring in sage-grouse habitat varied greatly by county, by state, and in a west-east direction.

INTRODUCTION

The greater sage-grouse (*Centrocercus urophasianus*) is the largest grouse species, occurring solely in sagebrush-dominated ecosystems throughout western North America (Connelly et al. 2004). Population trend data shows that while many subpopulations fluctuate and appear stable over given years, this species is overall in decline (Connelly et al. 2004). Models forecast that within the next 100 years, 75% of greater sage-grouse populations and 29% of Sage-Grouse Management Zones will likely fall below effective population sizes (Garton et al. 2011). Greater sage-grouse face numerous threats including (but not limited to): habitat loss, fragmentation and degradation, sagebrush destruction, woodland encroachment, drought, and altered fire regimes (BLM 2015; Cameron et al. 2008).

Studies reveal the importance of shrub canopy cover to sage-grouse nesting success and survival, indicating the benefits of habitats with variable shrub cover rather than sagebrush alone (Lockyer et al. 2015; Kolada et al. 2009; Popham and Gutierrez 2003). Historically, fire was the primary disturbance that influenced plant species composition within sagebrush habitats (Beck et al. 2008). However, the introduction of invasive cheatgrass has increased the frequency and severity of such fires, resulting in the loss of sagebrush communities (Beck et al. 2008). Prescribed fire has been a common method to reduce sagebrush on large tracts of rangeland, but research shows significant declines in sage-grouse breeding populations due to poor nesting habitat recovery years after burning (Connelly et al. 2000). Recently, the greater sage-grouse has been considered for listing under the Endangered Species Act due to the relatively high rates of population decline, however in 2015 they were deemed "not warranted" for protection under the

act (ECOS 2016). The goal and objective of this study is to quantify the acreage burned in sagegrouse habitat in northeastern California and northern Nevada from 1910-2015. Sage-grouse habitat will also be labeled as having high, average, or low value (Figure 2). It is imperative to continue research and monitoring of this species and their habitat to determine their eligibility for listing in the future.



Figure 1: Location of our study area indicated in blue. The study area encompasses the following counties: Elko, Eureka, Humboldt, Lander, Lassen, Modoc, Pershing, and Washoe.

METHODS

Study Area

The study area encompasses portions of northeastern California and northern Nevada and include the following counties: Elko, Eureka, Humboldt, Lander, Lassen, Modoc, Pershing, and Washoe (Figure 2). The areas are primarily managed by both the Bureau of Land Management (BLM) and the United States Forest Service (USFS). The area is dominated by three greater-sage grouse habitat classifications are as follows: Priority (PHMA), General (GHMA), and Other Habitat Management Areas (OHMA) (Figure 1). Priority habitat is classified as having the highest habitat value, whereas, general habitat consists of seasonally occupied habitat or year-round habitat. Other management areas are classified as areas of low habitat quality that are utilized by sage-grouse on a seasonal basis. The study area is located within the Great Basin desert which is a land mass that encompasses portions of California, Idaho, Nevada, Oregon, and Utah. The area is dominated by sagebrush, perennial grasses, and perennial forbs, all of which are extremely important to sage-grouse. Elevations within the Great Basin range from 3,900 to 9,800 feet above mean sea level (MSL). In addition, precipitation varies greatly from west to east and along elevational gradients. The primary source of precipitation within the region is in the form of late fall rains and snow during the winter months. The climate within the Great Basin is similar to that of Mediterranean climate where the summers are warm and dry and the winters are cold and wet.



Figure 2: Sage-grouse habitat by classification for northeastern California and northern Nevada. The area is dominated by three greater-sage grouse habitat classifications are as follows: Priority (PHMA), General (GHMA), and Other Habitat Management Areas (OHMA).

Data Acquisition and Analysis

In order to perform the analysis, data was acquired from the California Department of Forestry and Fire Protection (Cal-Fire), Bureau of Land Management (BLM), and the United States Forest Service (USFS). The following layers were retrieved: state and county boundaries, sage-grouse habitat classification, and fires occurring in California and Nevada from 1910 to 2015. All Meta data retrieved from these agencies were available for public use. All vector data was then projected into the following projected coordinate systems: NAD 1983 Zone 10N (California) and Zone 11N (Nevada). Vector data was analyzed using the following vector analysis tools: clip, select by attributes, Boolean operators (AND + OR), add field, calculate geometry, and summary statistics (Figure 3). Select by attributes tool was used to isolate the

following counties: Elko, Eureka, Humboldt, Lander, Lassen, Modoc, Pershing, and Washoe. In addition, the select by attributes tool was also used to isolate PHMA, GHMA, and OHMA habitat types from non-habitat. Furthermore, the select by attributes tool was also used to separate fires by decade. The clip tool was used to isolate fires that only occurred in sage-grouse habitat. Finally, the calculate geometry and summary statistics tools were used to determine the number of fires and acreage burned in sage-grouse habitat by decade.



Figure 3: Flow chart outlining all of the steps used to complete the analysis for quantifying acreage burned in sage-grouse habitat in northeastern California and northern Nevada.

RESULTS

Acreage burned varied greatly for each county and also in a west to east direction (Appendix A-G). For instance, over 97, 019 acres were burned from 1980 to 2015 in Washoe County. Conversely, during that same time period over 3,135,956 acres in Elko County. In addition, the number of fires occurring in sage-grouse habitat also varied greatly by county and in a west and east direction. For instance, there were 15 fires that occurred in Washoe County for 1980 to 2015; however, there were over 617 fires that occurred in Elko County during that same time period (Figure 4). Additionally, the acres burned and the number of fires occurring in sage-grouse habitat also varied by state as well. For instance, over 5,699,675 acres and over 1,424 fires burned in northern Nevada compared to just 726,780 and 462 fires burning in northeastern California.









Acres # of Fires









30000

2500

20000



Figure 4: Acreage burned and number of fires by decade for the following counties: A) Elko, B) Eureka, C) Humboldt, D) Lander, E) Pershing, F), Washoe, G) northern Nevada (All counties), and H) northeastern California (Lassen and Modoc).

DISCUSSION

An increase in fire frequency can promote conditions in which invasive annual grasses will dominate. Thus, sagebrush and perennial grasses will continue to disappear from these sites. Our results indicated that there has been a general increase in the acreage burned in sage-grouse habitat over the past two decades (Appendix A-G). This is especially true in portions of Elko County that have burned several times over the past 35 years (Appendix C). Management activities should be geared to monitoring sagebrush recruitment following fires and controlling the spread of invasive annual grasses through adaptive management actions. In some instances, restoration activities may be need to restore degraded areas to promote the reestablishment of native perennial grasses and shrubs, mainly sagebrush. However, these activities are very expensive and often have low chances of success. It is also important to understand that fires have always been a part of this ecosystem and are extremely important in altering seral stages, thus creating greater heterogeneity across the landscape. Currently, agencies across the range of the greater sage-grouse are actively involved in protecting the greater sage-grouse and also restoring their habitat so that their population overtime will rebound. Thus eliminating the need for listing under the Threatened and Endangered Species Act.

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Appendix A: Fires occurring in northeastern California and northern Nevada from 1910 to 2015.



<u>Appendix B:</u> Fires occurring in Lassen and Modoc counties in northeastern California from 1910 to 2015.



Appendix C: Fires occurring in Elko County in northeastern Nevada from 1980 to 2015.



Appendix D: Fires occurring in Humboldt County in northern Nevada from 1980 to 2015.



<u>Appendix E:</u> Fires occurring in Eureka and Lander counties in central Nevada from 1980 to 2015.



Appendix F: Fires occurring in Pershing County in southwestern Nevada from 1980 to 2015.



Appendix G: Fires occurring in Washoe County in northwestern Nevada from 1940 to 2015.