Rapid assessment photo points and plots assessing annual diversity and fire risk in Joshua Tree National Park

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Abstract

Annual plants comprise up to half the plant species at Joshua Tree National Park (JOTR). However, annuals face *a lot* of competition with non-native, invasive plants. At JOTR, the majority of non-native, invasive plants are members of *Brassicaceae* or *Poaceae*, the latter of the two creating a concern regarding fire. Non-native, invasive grasses benefit from fire, and promote recurring fires, to an extent that native species can no longer compete or persist and native plant assemblages are turned to non-native annual grasslands. The introduction of non-native invasive grasses, such as cheatgrass (*Bromus tectorum)* and red brome (*Bromus madritensis ssp. rubens*), to the Mojave and Sonoran deserts has increased biomass and continuity, allowing fire to spread in a landscape where fire was once restricted to isolated patches. These non-native annual grasses also have the ability to shorten the fire interval from 30-100 years down to as little as 5 years. These fires in turn create ideal soil composition for non-native grasses to return with an increase in density, creating a positive feedback loop for recurring fire and invasion. These fires also have the ability to convert highly diverse shrublands to low diversity non-native grasslands. To gain a better understanding of the community assemblages in JOTR, the potential effects of non-native annual plant presence, and fire risk, staff implemented a study consisting of rapid assessment photo points and permanent plots.

Methods

11 permanent plots and 39 photo points were installed in 2017 to collect data on community assemblages, invasive plant presence, and fire risk within JOTR. These plots and photo points were revisited in 2018 and 2019.

Permanent plots

Within a 10 x 10 m plot record all plant species present, as well as their corresponding percent cover. Along with percent cover for plant species, include covers for soil, rock, gravel, litter, standing dead native annuals, standing dead native perennials, standing dead invasive forbs, and standing dead invasive grass. Along the perimeter of the plot, point-intercepts are taken every 50 cm using a plumb-bob to record any plant species that the plumb-bob touches. Perennial plants are recorded if they are rooted within the plot and if the branch is dead, but the plant is alive; if the perennial plant is dead, it will be counted as standing dead native perennial. Frequency of plant species found within the plot it taken using a frequency quadrat. The quadrat is placed at 10 different locations around the eastern and northern edge of the plot using a frequency frame as shown in Figure 1. For each species present in the frame, the frequency is recorded as the smallest frame number in which the species occurs. Staff then assigned a fuel risk from 1 to 5, with 1 being low, based on professional opinion.

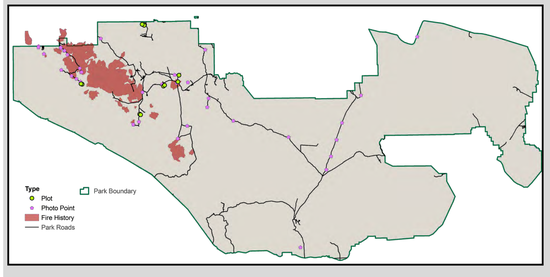

Figure 1: Map displaying plot locations and fire boundaries within JOTR

Top Left: Plant growth of a photo point in 2017 dominated by native annual plant growth

Top Right: Plant growth of the 2017 photo point in 2019 dominated by non-native invasive annual plant growth

Bottom Left: Plant growth at a 2018 photo point displaying plant species richness

Results

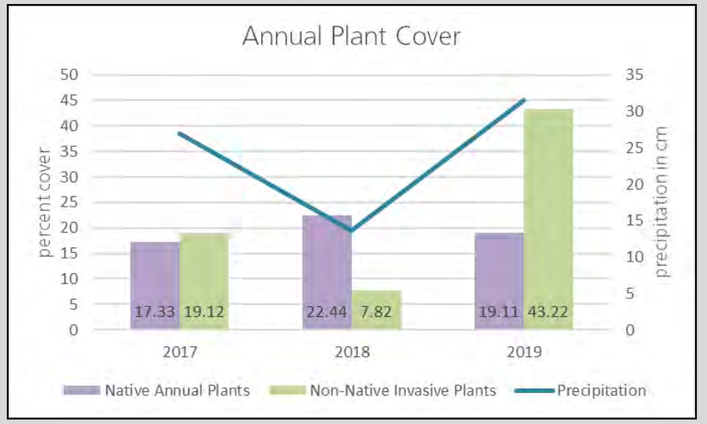

Figure 2: Percent cover in native and non-native, invasive annual plants each year overlaid with cm of precipitation recorded during the rain year.

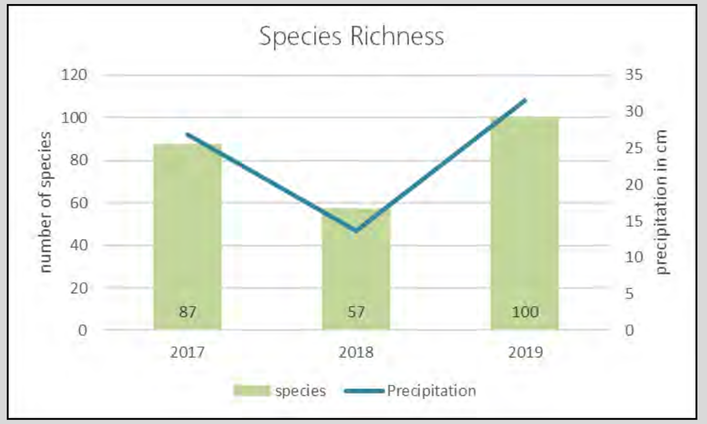

Figure 3: Number of plant species recorded in plots overlaid with cm of precipitation during the rain year.

- In 2017 and 2019, cover of non-native –invasive annual plants was higher than native annual plants.
- In 2018, a dry year, lower covers of non-native invasive plants and higher covers of native annuals plants were recorded.
- The correlation coefficient of non-native invasive annual plant cover and precipitation is 0.8874
- The correlation coefficient of native plant cover and precipitation is –0.8251
- In 2017 and 2019, more species were recorded (87 and 100l, respectively); in 2018, only 57 plant species were recorded.
- Fire risk in 2017 and 2018 was on average 2.6, while in 2019 it was 3.2

Discussion

From the data collected from 2017—19, it is evident that precipitation plays an important role in annual plant assemblage in JOTR. As illustrated in Figure 2, in 2018, precipitation was the lowest of the 3 years, and non-native invasive plant cover was also the lowest at 7%; however, native annual plant cover made up 22% of cover, remaining consistent as in other years.

In 2017 and 2019, native annual cover stayed consistent, while non-native invasive plant cover made up a higher percentage of cover. This data indicates that while non-native and invasive annual plants do well in wet years and may outcompete native annuals, they are less adapted to dry years and struggle to compete with native annuals. In 2017 and 2019, years in which El Niño weather patterns occurred, a greater number of plant species were found, but native annual cover was less than non-native invasive plant cover. In 2018, fewer plant species were recorded, but the native annual cover was higher than the non-native invasive cover, which may indicate a relationship between resource availability and annual plant growth. Further analysis of species richness data may reveal a relationship in which better adapted native species have an advantage to non-native invasive plants in dry years.

A better understanding of the relationship between environmental factors and annual plant assemblages will be valuable in the face of climate change. In scenario where the Mojave Desert is predicted to become hotter and wetter, non-native and invasive annual plants may outcompete native annuals. Conversely, in the scenario in which the Mojave Desert is predicted to become hotter and drier, native annual plant species may have a better competitive advantage over non-native, invasive annual plants. The data presented are limited in that they may not capture the high variability in annual plant composition and abundance throughout the park.