

Lee's Pincushion Cactus

(Escobaria sneedii var. leei)

Post-fire Monitoring Report 2017



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INTRODUCTION

Lee's pincushion cactus (*Escobaria sneedii* var. *leei*) is endemic to New Mexico, where it is restricted to the Carlsbad Caverns National Park area in the Guadalupe Mountains of Eddy County. It occurs primarily in cracks of limestone outcrops, in areas of broken terrain and steep slopes in Chihuahuan desert scrub communities between 4,000 and 5,000 ft in elevation (Figure 1).



Figure 1. Habitat of Lee's pincushion cactus at Carlsbad Caverns National Park.

Lee's pincushion cactus was listed as a threatened species under the Federal Endangered Species Act on October 25, 1979 (44 FR 61554 61556). The primary reasons for listing were illegal collection and road construction. Fire was not listed as a threat in 1979, nor in the 1986 recovery plan. In fact, the recovery plan considered fire a potential positive impact on plants, due to the elimination of competing vegetation (USFWS 1986). However, the recovery plan listed studying the impacts of fire on Lee's pincushion cactus as an action that must be taken to prevent a significant decline in the species' population or habitat quality.

Since 2010, multiple fires have burned roughly half of the land area within Carlsbad Cavern National Park, including a significant portion of occupied habitat of Lee's pincushion cactus. In 2011, the Loop Fire burned 8,221 acres of desert lands within the Park, including a large number of these rare cacti. Limited data on the status of a small population of cacti immediately post-fire is available, but we do not know the long-term impacts on survival, reproduction, vigor, and recruitment in response to fire (NPS 2011, NHNM 2012). Ongoing drought and predicted increases in severity and frequency of fires in the Southwest have caused serious concerns about the continued survival of these cacti. The primary objective of this study is to document the response of Lee's pincushion cactus to fire, with the goal of documenting post-fire recovery and providing long-term population trend information.

METHODS

In May of 2014, sixty monitoring plots were established in an area burned in the 2011 Loop Fire and 60 monitoring plots were established in an adjacent unburned area in the Rattlesnake Canyon area. Monitoring plots are 1 m in radius and contain at least one plant (dead or alive). The center of each monitoring plot is marked with a metal tag fastened on a nail (Figure 2). Monitoring plot locations were mapped using a Trimble GPS. All cacti rooted inside each monitoring plot were tagged with individually numbered round metal tags (Figure 3). Clusters of cacti were considered individuals if they were more than 6 inches apart from each other. Annual data collected includes the overall vigor of each plant in each plot (1 = excellent, 2 = good, 3 = fair, 4 = poor, 5 = dead), the estimated number of living and dead stems, and the number of reproductive structures of each plant (flowers, fruits). Monitoring plot locations in burned and unburned areas were chosen from a sample of previously recorded cacti. Locational data for these cacti was provided by Natural Heritage New Mexico (NHNM 2012) and/or Carlsbad Caverns National Park (NPS 2011). Annual spring monitoring occurred in 2017 from April 25 through April 26.



Figure 2. Center of monitoring plot (rectangular metal tag) behind a burned Lee's pincushion cactus plant.



Figure 3. Tagged individual of Lee's pincushion cactus.



RESULTS

In 2017, the 60 unburned area plots established in 2014 contained a total of 91 cacti, 71 of which were alive. Only one of the plants died since the initial set-up of the plots in 2014. No new plants were found in the unburned plots in 2015, 2016, or 2017. The 60 burned area plots contained a total of 89 cacti in 2017, 65 of which were alive in the spring of 2017. Four of the plants had died since 2016. Three new plants were recorded in the burned monitoring plots. A total of 6 new plants have been recorded in the 60 burned monitoring plots since they were established in 2014.

In 2017, 76% of the live plants in the unburned plots were reproductive, containing flowers or fruits (Figure 4). A total of 577 flowers and fruits were found on 54 plants. Fifty-seven percent of live plants in the burned plots were reproductive. A total of 465 flowers and fruits were found on 35 plants. The total number of stems recorded for the 71 live cacti in unburned area was 3,228, including approximately 5% dead stems. The total number of stems recorded for the 65 live cacti in the burned area was 2,847, also including approximately 5% dead stems. The percent of dead stems within each population has significantly declined in the 4 years of monitoring. In 2014, 24 % of the total number of stems in unburned plants were dead and 26% of the total number of stems in the burned plots were dead. The majority of plants in both burned and unburned areas were considered in excellent or good condition during all four monitoring years (Figure 5).

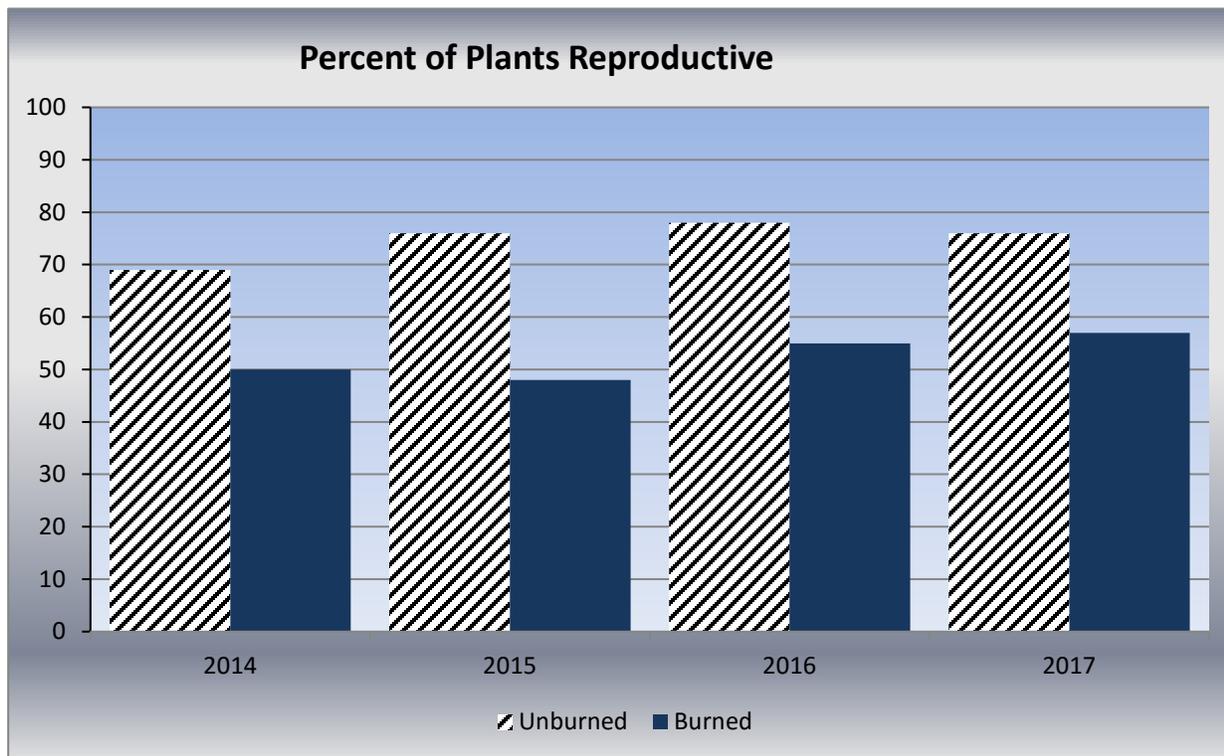


Figure 4. Lee’s pincushion cactus reproductive effort in burned and unburned monitoring plots at Carlsbad Caverns National Park, New Mexico.

Little or no mortality has been recorded since the initial set-up of the monitoring plots. The cause of mortality of the 12 dead plants initially recorded in the 2014 unburned plots is unknown, but was likely due to drought conditions. The cause of mortality in the burned plots is presumed to be primarily from direct impacts from the 2011 Loop Fire. Sixty-three of the 86 plants recorded in the 60 burned monitoring plots in 2014 were plants that were also recorded in 2011 (NPS 2011) and 2012 (NHNM 2012) (Table 1). Six of the 10 plants found dead in 2011 showed no signs of recovery and were still considered dead in 2014. Four of the plants found dead in 2011 had recovered some live stems in 2014. Five additional plants had died between 2011 and 2012 and seven additional plants died between 2012 and 2014. All 18 of the (2011 & 2012) plants found dead in 2014 and the three dead plants found in 2015 were recorded as partially burned in 2011. The cause of mortality for the 4 newly dead plants found in 2017 is unknown.

Table 1. Number of plants found alive or dead immediately after the 2011 Loop Fire, in 2012, and 2014.

| | NPS 2011 | NHNM 2012 | EMNRD 2014 |
|-------------------------------|-----------------|------------------|-------------------|
| Live | 37 | 43 | 45 |
| Dead | 10 | 17 | 18 |
| Unknown Status | 12 | 3 | 0 |
| Total Number of Plants | 59 | 63 | 63 |

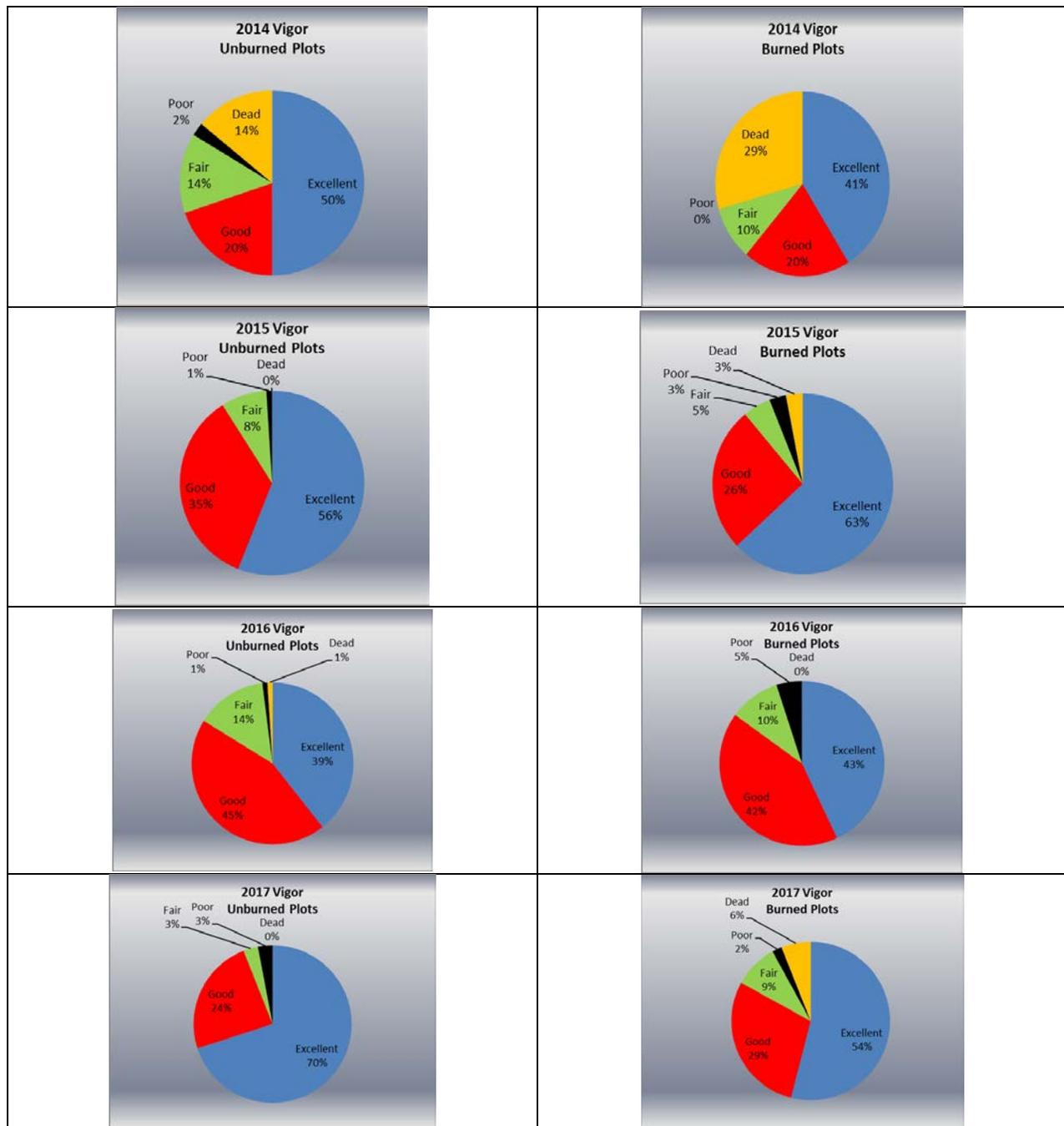


Figure 5. Vigor of Lee's pincushion cactus plants in burned and unburned monitoring plots at Carlsbad Caverns National Park, New Mexico.

DISCUSSION

A total of 31 plants of the 91 plants recorded in the burned area were dead in 2017. Twenty-two of these were documented as partially burned or dead and burned in 2011. The remaining seven plants that were found dead in the initial set-up of the monitoring plots had no previous records and therefore we do not know for certain whether they were burned in 2011 or not. Fires burn patchy and not all cacti inside the fire perimeter were burned during the 2011 Loop Fire (NPS 2011, NHNM 2012). In addition, some plants did not burn because they were growing on rocky outcrops where the fire did not impact them (Muldavin *et al.* 2013). The initial rate of mortality among 131 plants located inside the Loop Fire was estimated at 40.5 % two growing seasons after the fire (Muldavin *et al.* 2013). Although it is likely that these 7 cacti also died as a consequence of the fire, by 2014 it was difficult to estimate where microsites had burned and impacted the cacti because the habitat was largely recovered (Figure 6). Two additional mortalities were recorded until 2015 and 4 plants died between 2016 and 2017. Four of these cacti were recorded as partially burned in 2012. It appears that the majority of fire-related mortalities occur within one to two years of a fire.

Initial mortality in the unburned areas was likely caused by drought conditions. Total rainfall amounts in the Park were 6.74 inches in 2011, significantly lower than the 60-year average of 14.74 inches (WRCC 2018). This is also supported by the large percentage of dead stems recorded in 2014. Dead plants and individual dead stems were still present in 2014, showing no signs of damage or predation (Figure 7). Plants are covered by dense spines and therefore it can be difficult to determine whether a plant is dead or alive, especially if the stems remain after the plants died from drought or insect predation (stems hollowed out). Dead stems can remain on site for several years. Only one new mortality has been documented in four years of monitoring unburned plots.

In addition, it can take a cactus several years to succumb to injury sustained by fire or other disturbances. Even after a plant has been removed by fire or predation, it can apparently resprout from the root, or reestablish from the seedbank which is expected to be in the immediate surrounding area where the parent plant once grew. Therefore, any recovery is likely to occur in areas immediately adjacent to dead plants. However, even though rainfall amounts were near average since 2014, recruitment of new individuals has not been documented from unburned plots and only six new recruits were documented in burned plots.

The percentage of reproductive effort remains significantly larger among unburned vs. the burned plants. This is likely a result of having fewer mature live stems present in the burned areas, as these plants are recovering from fire damage and many stems may be too young to be reproductive, even six years after the fire.

Six years after the 2011 Loop Fire recovery remains slow and there is no evidence of increased or decreased recruitment in response to the fire. Recruitment is low to non-existent in both burned and unburned plots, despite relatively good years of rainfall since the 2011 fire. In addition to the initial mortality of plants, reproductive effort of the surviving plants remains lower than the reproductive effort observed in unburned areas. Therefore, fire does not benefit these cacti by initiating increased reproduction or recruitment, but provides a setback in population trends for a species that naturally already exhibits low recruitment rates.

Continued monitoring burned and unburned areas will not only document the recovery of the population within the Loop Fire perimeter, but will also document how long it will take for a population to restore full reproductive capacity. Not only will long term monitoring provide land managers with documentation of recovery, but also provide baseline information of overall population trends of the species. This will help guide management actions in response to future wildfires and inform proper planning for prescribed fires and other management activities. In addition, population monitoring and studying the impacts of fires on this federally listed species are key tasks that need to be accomplished for the recovery of Lee's pincushion cactus (USFWS 1986).



Figure 6. Recovering habitat of Lee's pincushion cactus, 3 years after the Loop Fire.



Figure 7. Dead Lee's pincushion cactus plant in the unburned area.

LITERATURE CITED

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