Flowers Penstemon Monitoring
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Prepared for: The Nature Conservancy

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Introduction

Flowers penstemon (*Penstemon flowersii*) is an endemic plant known only in the Uinta Basin, Utah. The range of *F. penstemon* is limited to an area approximately 32 km long and 6.4 km wide. The species was petitioned for protection under the Endangered Species Act in 2010. At the time, little was known about the species, and no immediate threats were identified, so U.S. Fish and Wildlife Service (USFWS) denied the petition (USFWS 2011).

Since the 2011 USFWS decision, the Uinta Basin has experienced a boom in energy development, and oil and gas drilling has increased significantly within the limited habitat range of *F. penstemon*. The Nature Conservancy began funding monitoring efforts in 2015, which have continued yearly with 2019 being year five of monitoring. Results of monitoring show *F. penstemon* is susceptible to annual precipitation but is currently most threatened by oil and gas development.

This report will review the findings of 2019 monitoring, summarize findings over the last five years, discuss the documentation of dormancy, and provide recommendations for future monitoring and conservation of this species, which is complicated by the fact that it is located almost entirely on private and tribal lands. With the documentation of dormancy, the term "reemerging" will be used when referring to mature plants that were dormant the previous year, but present in the current year of monitoring. The "emergent" refers to mature plants present in both the current and prior years.

Monitoring

The monitoring for 2019 was completed on May 18th and 20th. The winter of 2018 into the spring of 2019 had above average levels of precipitation, which was evident in the abundance and vigor of vegetation. The abundance of cheatgrass and other vegetation made it difficult to see plants, so extra care was taken to look carefully for plants in plots and transects.

Tagged Plants

Thirty-two of the thirty-five tagged plants were located. Tagged plants #3 and #11 were not found, but the caudex was located and determined to be dead, so two new plants were tagged to replace these. Tagged plant #27 was also missing, and two dead stems were found, but the caudex was not found, so this plant was listed as dormant. If it does not reemerge in 2020, the status will be changed to dead, and a new tagged plant will be selected.

Tagged plant conditions in 2019 were overall improved from 2018 with 17 in excellent condition, 14 in good condition, 1 in fair condition, 2 dead, and 1 dormant (Figure 1). Monitoring in 2018 showed 26 plants in fair condition and 9 plants dead or dormant. Thus, 2019 monitoring allows for official documentation of *F. penstemon* going dormant, most likely a result of drought in 2018.

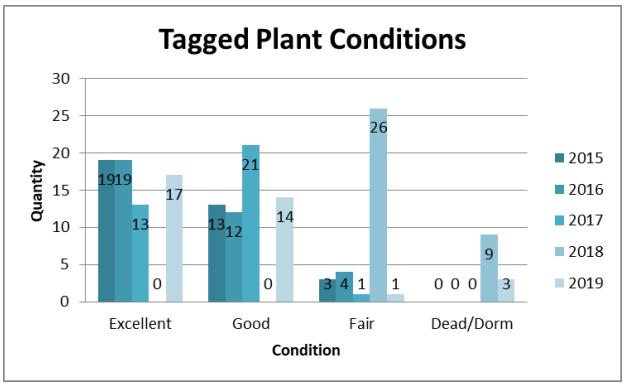

Figure 1 - Tagged Plant Conditions 2015 - 2019

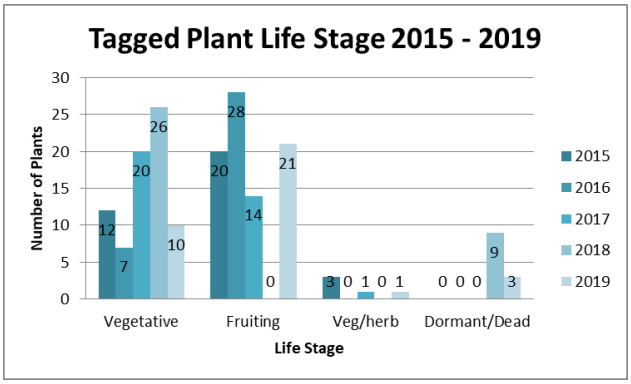

Figure 2 - Tagged Plant Life Stage over five years of monitoring.

Tagged plants also showed a significant increase in flowering/fruiting in 2019 as compared to 2018, with only 10 plants being vegetative (Figure 2). Again, this is likely due to the wet winter and spring (USU, 2020).

The tagged plants were also assessed for herbivory, which was surprisingly low given the large number of caterpillars seen during monitoring. While caterpillars were seen on the F. penstemon plants, they were much more abundant in other

Figure 3 - Painted Lady Larvae (*Vanessa cardui*)

plant species. The caterpillars were later identified as painted lady larvae (*Vanessa cardui*), which had a population boom in 2019 (Stout, 2020).

A total of 10 plants showed signs of herbivory, 7 mild, 2 moderate, and only 1 severe (Figures 2 and 3). Tagged plant #5 had severe herbivory and was the only tagged plant vegetative due to herbivory.

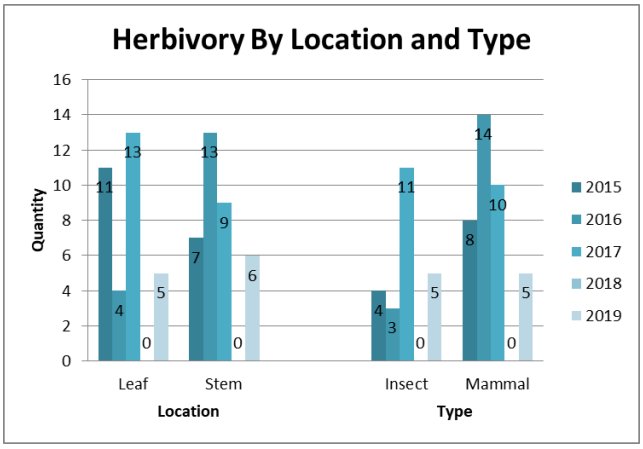

Figure 4 - Herbivory by location on the plant and type.

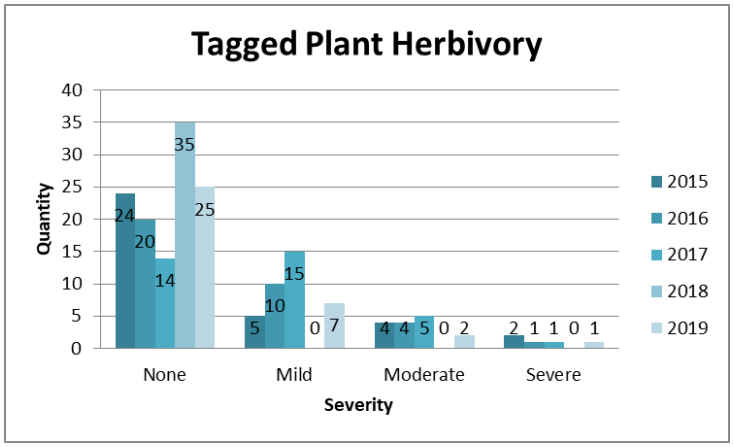

Figure 5 - Severity of herbivory in tagged plants.

As mentioned previously, two new plants were tagged to replace #3 and #11, which were dead. Tags #36 and #37 were assigned to the new plants, which were chosen randomly as the first plant seen near the dead plant. Tag #36 was placed at 579081.14 easting 4455808.15 northing, on a vegetative plant in excellent condition with no herbivory. Tag #37 was set at 585100.46 easting; 4450296.96 northing, on a fruiting plant in excellent condition with no herbivory.

Plots

Plots were monitored with all *F. penstemon* plants being counted and assessed for the life stage. A total of 89 plants were counted in plots, which is an increase from last year,

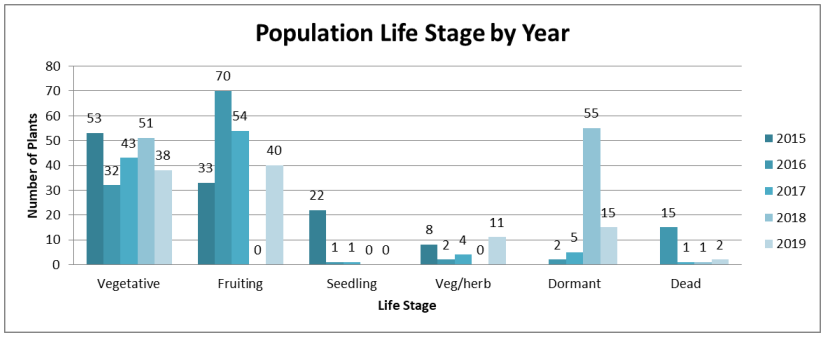

Figure 6 - Life stages of the plants counted in plots each year.

but still lower than the first three years.

When mature plants were noticed that had not been noted the previous year, earlier plot diagrams were reviewed. The review showed the new plants matched locations of plants previously marked dead/dormant, so a careful audit was conducted of all plot diagrams and plot photos. Diagrams were compared to plot photos, and plot photos were analyzed for each year of monitoring. Each plant was given a unique identifier and drawn onto a master plot diagram so that dormancy could be tracked.

The review of plot photos resulted in some key observations, and some corrections were made. The most significant observation was the discovery that some plants marked as seedlings were reemerging adults. The close appearance between some seedlings and reemerging adults led to research of all pictures and seedlings of other penstemon species in an attempt to clarify the characteristics of seedlings.

Previously, seedlings had been identified by size and/or the presence of cotyledons. However, it was noted that mature plants frequently had basal leaves that looked like cotyledons, but were documented adults. Ultimately it was noticed that seedlings were usually a somewhat darker green, had a tighter rosette, and slightly rounded leaves in general (not just the cotyledons), whereas reemerging adults had an open rosette and longer, pointed leaves. This determination was made in part by comparing plants known to be dormant with those suspected as seedlings.

As a result of the review, the total population count was lowered to 122 documented plants, and the total seedling count was reduced from 36 to 24. The 12 plant reduction in seedlings was made up of 5 seedlings that were reemerging adults, 6 adults misidentified as seedlings, 2 plants were a secondary stem of an existing adult and not a new plant, and one new seedling was identified that had been missed previously.

All plot diagrams were updated to show dormant plants which were also labeled with the year they went dormant. Plants previously marked as dead were changed to dormant (with the exception of those known to be dead), and life tables were amended and recalculated with a value of dormant instead of dead for those plants that had reemerged.

After the review, it was noted that no seedlings that had gone dormant had ever reemerged, which would make sense as seedlings would probably not have developed a root system sufficient to support dormancy. There were 16 seedlings marked as dormant, which were changed to dead as it is highly unlikely they could be dormant for 2 to 4 years. The adjustments resulted in a seedling recruitment rate of 37.5%.

The discovery of mature plants dormant for more than a single year presents some challenges in calculating life expectancy and survival. Additional research was done, and modeling methods explored. Accuracy of these models increases with time and sample size, so attempts will be made to apply modeling in the future (Alahuhta, et al., 2017).

Transects

A total of 195 plants were counted during transect monitoring, which is an increase from 2018, but still less than the initial count in 2015. The increase of 104 plants in a single year when no seedlings were found, suggests the plants had been dormant during 2018, and additional plants could still be dormant.

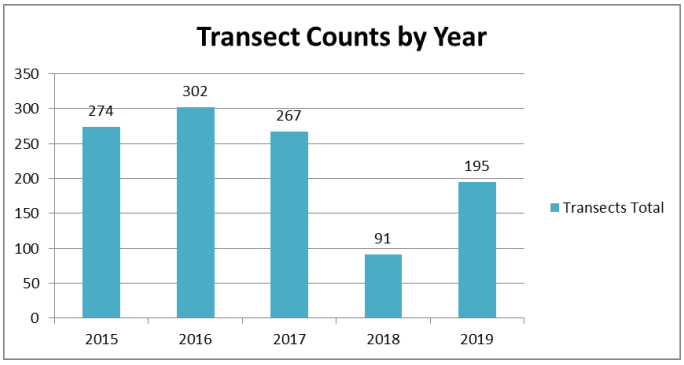

Figure 7 - Total plants counted in transects by year.

Where the transect plants have been counted, but no individuals or life stages have been recorded, there is no way to determine the number of dormant plants. However, the percentage of

population change closely matches that of plants in plots. Marking the locations of plants along transects in the future may be beneficial in helping to more accurately document dormancy in this species.

Dormancy

Determining dormancy has been a very complex process, and the plot diagrams were essential in getting accurate counts. A total of 122 individuals plants have been counted in study plots over the 5 years of monitoring, so this number was used as a population size to summarize the last 5 years. A total of 19 (16 seedlings and 3 adults) have died (15% of the total population).

A total of 63 plants have been dormant at some point over the last 5 years (51% of the population). The majority of the population was dormant only one year, with the majority of these being in 2018, most likely as a result of the severe drought that year. Five plants reemerged as adults in 2016, with no way of knowing how long they had been dormant. However, since most plants have been dormant only one year, these five were included with the plants that reemerged after 1 year in this chart.

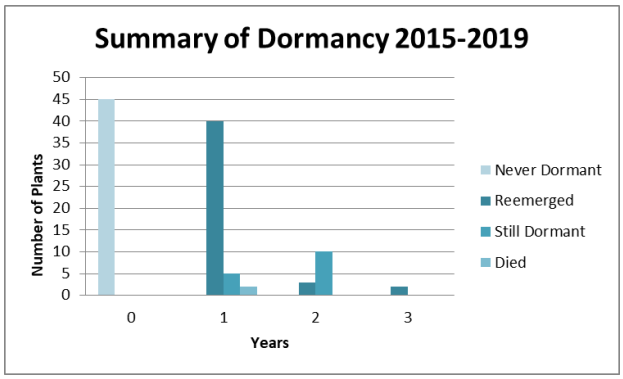

Figure 8 - Chart showing plants that were never dormant, the length of time dormant before reemerging, number of plants still dormant, and plants that died after being dormant.

The question arose of how many plants in transects had been dormant and reemerged and whether the change in the number of plants in transects matched the change in numbers documented in plots. When the numbers were graphed, the trend lines were close, so the correlation

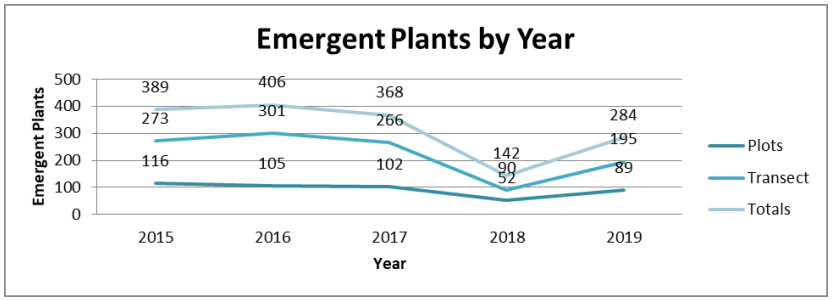

Figure 9 - Emergent Plants by year comparing trend lines for plots and transects

was calculated. Since the comparison was for the percentage of change, the highest yearly count for each sample was used as the population count, and the percentage of change was calculated. These percentages were used to calculate correlation, which was 96%.

Given the correlation, the percentages of plants in plots were applied to transects for multiple scenarios, including seedling recruitment, mature plant dormancy, death rate, reemergence after multiple years of dormancy, and probability of reemergence after dormancy.

Since recruiting seedlings are part of the dormant adult population, seedling abundance was first estimated at 19.5% of the population or 58 seedlings. Of those 58 seedlings, 37.5% or 22 plants would have recruited. This would make the population size 323. However, 2% of the adult population would have died or 6 plants, making the population 317. Applying the 59% dormancy rate, 187 plants would have gone dormant, 60% or 112 would likely have reemerged after 1 year, and 35% or 65 plants would still be dormant. Using 2018 as a reference, where it had the highest dormancy rate, the count for 2018 was 90; it increased by 105 plants to 195 in 2019. This number is close to the projected 112 plants. If the calculations are as close for 2020, approximately 60 more plants will reemerge in 2020.

Seedlings have not been commonly seen in transects, and the seedling rate may be overly abundant. All of the seedlings found in plots have occurred in 6 of the 35 plots. The only common factor of these plots is that they are at or near the base of slopes and may receive abundant water. However, there are other plots similarly placed that have not had any documented seedlings. Additional investigation of these six plots for commonalities may be beneficial.

Recommendations

Continued monitoring is recommended for at least an additional five years. The greatest limiting factor in protecting this species has been a lack of information. Models to predict population growth or decline, when dormancy is involved, improve in accuracy with the length of monitoring time. An

additional five years would provide the time to improve model accuracy, and also allow for adjustments in monitoring to obtain better data on dormancy (Alahuhta, et al., 2017).

Recommended adjustments to monitoring would include diagramming transects to determine seedling rates and accurately measure dormancy. These diagrams would also allow for an increased population size when running the models to increase accuracy.

Where oil and gas development continues to be the major threat to this species, initiating a conservation agreement with the Ute Tribe, Duchesne and Uintah Counties, private landowners where possible, energy companies, and the Bureau of Reclamation is recommended. The low seedling count for this species suggests it is of utmost importance to protect mature plants. Where these plants tend to grow in patches, it would be possible to work with landowners, energy companies, and the Ute Tribe to adjust the location of wells pads and roads to minimize the take of mature plants.

The Dude Young property is still experiencing a high rate of disturbance from recreation, including off-road vehicles, shooting, and activities such as dumping of garbage. The off-road vehicles have caused a spread in invasive species, erosion of soils, and damage to habitat and *F. penstemon* plants. The spread of cheatgrass (*Bromus tectorum*) has created an increased risk of fire, especially with the shooting and off-road activities. Past recommendations have included deeding the property to the BLM or USFWS for management, signage, and strategic placement of boulders to prevent off-road destruction.

The Dude Young property is the only Federal location for *F. penstemon* and must be protected. This parcel of land also has multiple resources needing protection, and off-road activities should be prohibited. Resources at this location include archaeologic sites, habitat for three Federally-listed species, and a riparian corridor with water flowing into the Green River, which could potentially impact Federally-listed fish (Table 1).

Table 1 - Federally-listed species associated with the Dude Young property

Species	**Status**
Uinta Basin Hookless Cactus (*Sclerocactus wetlandicus*)	Threatened
Pariette Cactus (*Sclerocactus brevispinus*)	Threatened
Western Yellow-billed Cuckoo (*Coccyzus americanus*)	Threatened
Bonytail Chub (*Gila elegans*)	Endangered
Humpback Chub (*Gila cypha*)	Endangered
Razorback Sucker (*Xyrauchen texanus*)	Endangered
Colorado Pike Minnow (*Ptychocheilus lucius*)	Endangered

Petitioning *F. penstemon* for protection under The Endangered Species Act remains an option, but this would not provide protection on private lands and would put the majority of species protection on the Ute Tribe. Continued monitoring would allow for further research on dormancy and allow for more accurate use of population models.

Works Cited

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