

Swale Paintbrush

(Castilleja ornata)

Status Survey Report 2020



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INTRODUCTION

In 2009, the USFWS issued a 90-day finding in response to a petition to list *Castilleja ornata* (swale paintbrush, glowing Indian paintbrush, ornate paintbrush) as threatened or endangered under the federal Endangered Species Act (74 FR 66866). The USFWS determined that listing the species as threatened or endangered may be warranted due to the present or threatened destruction, modification, or curtailment of its habitat or range resulting from improper grazing, or conversion to cultivated cropland. In response to this finding the USFWS is required to review the status of the species based on best available scientific and commercial information available. A status report based on surveys in 2017 documented only 2 plants from historically known sites (Roth 2017). Documented and potential threats include habitat conversion, land use, climate change, and possibly the construction of the border wall, including associated access roads and staging areas.

The primary goal of this status report is to provide information on the current status of this species in the United States. The objectives of the status survey were to

1. Survey historic population sites, including the 2017 extant site
2. Determine the current status, abundance, and threats.

Species Description



Castilleja ornata is an annual herb with 1 to several erect stems, 2-5 dm tall with long-villose, non-glandular hairs mixed with shorter gland-tipped hairs; leaves oblong to lanceolate, unlobed, 3-nerved, 2-4 cm long, with strongly wavy margins and bases clasping the stem; floral bracts are unlobed, broadly rounded, wider above than below, wavy-margined, ochroleucous to very pale yellow on the upper third, often fading to dull red with age, glandular-puberulent; primary clefts of calyx 1 cm deep, secondary clefts emarginate; hooded upper corolla lobe (galea) exserted, 5 mm long, green. *Castilleja ornata* flowers from July through September (NMRPTC 1999).

Distribution and Habitat

Castilleja ornata grows in flat, seasonally wet areas in arid grasslands at an elevation of 1,570 m (5,160 ft). *Castilleja ornata* occurs in southwestern Hidalgo County, New Mexico, which is the only known location in the United States (Figure 1). It is also documented from western Chihuahua and west-

central Durango in Mexico. The status of this species in Mexico is poorly known, but searches of the few historical collection sites in Chihuahua have failed to locate a single extant population (NMRPTC 1999). Mexican sites visited have apparently been fully converted to agriculture.

Castilleja ornata was first documented by Laird McIntosh from the Diamond A Ranch (previously Gray Ranch) in 1993 (McIntosh 1994). A more detailed survey of the Diamond A Ranch site in 1994 found plants distributed in 3 small sites (sub populations), all within several hundred feet of the Fitzpatrick Camp (Egger 1994; Figure 1). Plants were described as locally common, ranging from 50 to 800 individuals per site. Prior to 2017 the most recent documentation from the Diamond A Ranch was from 1998 (K.D. Heil 12468, 8/13/1998; UNM 96508). No information was given on the abundance of plants at the collection site.

METHODS

Original location and descriptive data came from reports (Egger 1994, McIntosh 1994, Roth 2017), the NM Natural Heritage Program, and SEINet. Plant locations and survey routes were mapped with a Garmin Monterra GPS and a Samsung Galaxy Tab S2 tablet, using the ArcGIS Collector App. Surveys were performed by 2 people, during optimum flowering season to maximize detection of plants, during the last week of August 2020. The focus was to locate and assess the status of the known population in the vicinity of the Fitzpatrick Camp on the Diamond A Ranch in Hidalgo County. In addition, we surveyed an area burned in January of 2019 on the west and southwest side of the Fitzpatrick Camp to assess the potential for the species to be fire dependent, requiring fire to thrive.

RESULTS

In 2020 31 plants were found at 5 sites within 200 ft of where plants were found in 2017 (Figure 1). The number of plants at the 5 sites ranged from 1 to 15 plants. Three individuals were found within the immediate vicinity of the site where 2 plants were found in 2017. This location is also within one of the three polygons mapped in 1994. All plants were in full flower, one plant was partly eaten. No plants were found anywhere else, including the other two historically mapped polygons and the burned area west and southwest of the Fitzpatrick Camp. Plants were not associated with disturbed sites or shallow swales mostly dominated by invasive annual plants, but were strictly associated with dense stands of primarily alkali sacaton (Figure 2). The associated plant community surrounding the Fitzpatrick Camp is composed primarily of alkali sacaton (*Sporobolus airoides*) mixed with western ragweed (*Ambrosia psilostachya*). Other associated species include Baltic rush (*Juncus arcticus*), buffalo gourd (*Cucurbita foetidissima*), common kochia (*Kochia scoparia*), Texas blueweed (*Helianthus ciliaris*), longleaf false goldeneye (*Heliomeris longifolia* var. *annua*), annual pepperweed (*Lepidium* sp.), Russian thistle (*Salsola tragus*) and Powell's amaranth (*Amaranthus powellii*). Shallow swales are mostly dominated by western ragweed, Baltic rush, buffalo gourd, Russian thistle, pepperweed and kochia.

The discovery of 31 plants prompted the need for collecting seeds for ex-situ conservation purposes. Additional permits were obtained from the Diamond A Ranch and seeds were collected on September 29, 2020, from all plants that could be found again, using Center for Plant Conservation guidelines and a draft USFWS collection protocol. In addition, seeds of the dominant associated grass species, alkali sacaton (*Sporobolus airoides*) were collected due to the hemiparasitic

nature of *Castillejas*. Approximately 10% of seeds produced from each plant was collected and stored in separate seed packages. Seeds are stored at the Albuquerque BioPark in Albuquerque, NM.

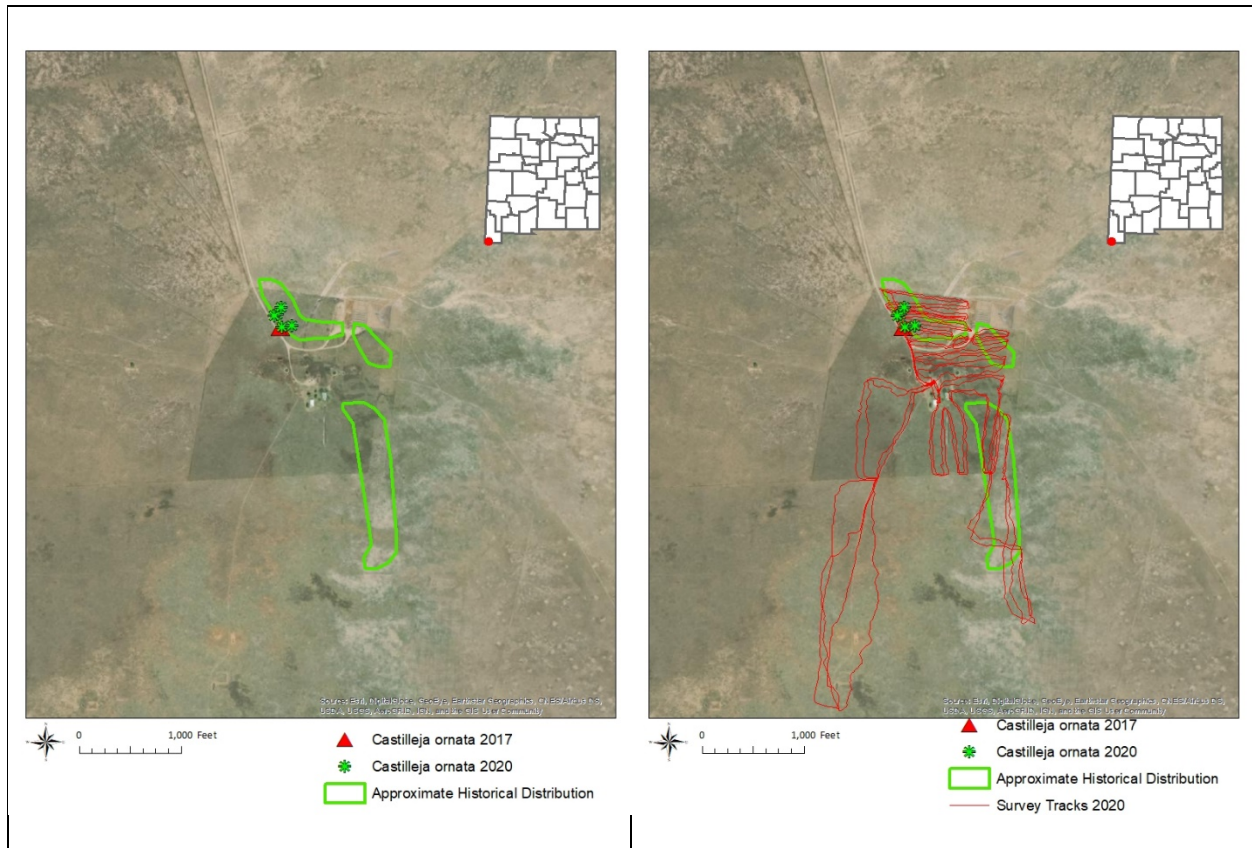


Figure 1. Survey routes and location of the 1994, 2017, and 2020 populations of *Castilleja ornata*, at the Fitzpatrick Camp, Diamond A Ranch, in Hidalgo County, NM.



Figure 2. *Castilleja ornata* in its habitat

DISCUSSION

Extensive surveys in 2017 found only 2 individuals of *Castilleja ornata* in one location. In 2020 31 individuals were located in the same general area, which is also one of the three historical sites for the species. Surveys did not find any plants in the other 2 historically occupied sites (Figure 1).

Precipitation amounts drive the variability in the abundance of annual plants. In arid systems, water availability and timing are known to be limiting factors influencing germination and establishment of annual plants. *Castilleja ornata* is an annual plant, likely germinating with the onset of the summer monsoon rains (typically in early July), flowering in August and September. Although we have no specific historical rainfall record for the Diamond A Ranch, the average annual precipitation in nearby Antelope Wells is 13.27 inches, ranging from 4.99 inches in 2003 to 20.96 inches in 1991, over a 17-year period (WRCC 2020). Rainfall totals were somewhat below that average in 2017 when only 2 plants were found (12.01”). In general, the majority of rainfall is received during the summer monsoons, between late June and early October. The critical rainfall period for *C. ornata* is presumed to be from June through August, when plants germinate, establish, and flower. In 1993 and 1994, when hundreds of plants were documented from the Diamond A Ranch population during August, total rainfall amounts between June and August were 3.35 and 1.93 inches, respectively (in Animas). Summer monsoons (June – September) brought a total of 7.54 inches of rain to Antelope Wells in 2017 vs. 2.76 inches in 2020. Although the winter of 2019/2020 had above average rainfalls, the following spring and summer were exceptionally dry. Yet we found 31 plants. No clear pattern emerges and it appears that plant abundance is apparently not directly correlated to rainfall amounts, either due to the lack of a seed bank or another unknown variable influencing germination and establishment.

Between 2014 and 2016 a variety of improvements to the land were implemented surrounding the Fitzpatrick Camp. These included the removal of livestock from the vicinity of the facilities and housing, the removal of the original corral and the relocation of the corral to the NE of the ranch house, on-site burial of the original corral, trenching to divert water flow away from the ranch house and new corral, and expansion of the fenced area to the north, northwest and the east. The improvements took place in the immediate vicinity of the two historic population sites north of the ranch house. These ground disturbing activities may have altered local hydrology to a degree that the habitat is longer conducive to the germination and establishment of the species. It is possible that the population is recovering from this disturbance, where the habitat is still suitable.

Improvements near the southernmost population were significantly fewer, consisting primarily of the outward relocation of the eastern fence boundary. Historically the largest population was located southeast of the Fitzpatrick Camp. No plants were found within the historically mapped area in 2017 or 2020, inside and outside of the fenced area. Some annual species require a degree of disturbance to remove competition for resources with other, more aggressive perennial species, such as bunch grasses. The removal of livestock inside the fenced area may have increased the competition with perennial bunchgrasses. However, based on previous surveys and photo documentation, *C. ornata* can be abundant even in the presence of dense stands of perennial grasses (Roth 2017). *Castilleja* species have a hemiparasitic relationship with surrounding plants and depend on these plants for nutrients and water through a root connection (Meyer and Carlson 2004). It is likely that *C. ornata* has a hemiparasitic relationship with alkali sacaton (*Sporobolus airoides*), the

dominant bunch grass in the habitat surrounding the Fitzpatrick Camp. *Castillejas* are generally not palatable to livestock and some species are even known to be toxic to livestock. In addition, the density of associated species was markedly lower outside the fenced area, where grazing is permitted and livestock gets seasonally herded towards the corrals just to the north, yet no plants were found in the area.

Wildfire can be an important natural disturbance on densely vegetated grasslands, such as those found on the Diamond A Ranch. Fire may in fact be essential to maintaining the health of short-grass and mixed-grass prairie. To test the hypothesis of *Castilleja ornata* being a possible fire dependent species, we surveyed a recently burned area in the immediate vicinity of the known extant site west and southwest of the ranch house, where similar habitat conditions and associated species prevailed (Figure 1). No plants were found.

Our knowledge of the ecological and biological requirements of *C. ornata* are limited at best, but in the absence of species specific knowledge, we can infer certain traits from other, better known *Castillejas*, such as the hemiparasitic habit of most *Castillejas*, small seed size, and palatability to livestock. We have no knowledge of the seed bank dynamics and viability of *Castilleja ornata*. Seeds of *Castilleja* species tend to be very small. Although it is presumed that a proportion of seeds produced by annual desert plants remain dormant after a germination event, small seeds are associated with greater variance in reproductive success and may not persist for very long in the seed bank (Pake and Venable 1996; Skogen et al. 2010). It is possible that prolonged drought conditions after 1994 have gradually reduced the seed input into the seed bank and that drought in combination with ground disturbing activities and habitat alterations have contributed to the overall decline of the species.

Other possible causes or contributors to the observed decline may be pollinator limitations and pollination success, and unknown pathogens or predators impacting plants through time.

RECOMMENDATIONS

Castilleja ornata is an annual species possibly exhibiting wide fluctuations in plant numbers from year to year. We know very little about the seed bank dynamics of the species. There is the potential that the species recovers when conditions are conducive to germination and establishment of these plants. Known historic sites surrounding the Fitzpatrick Camp should be monitored annually for several years to document a possible return of this species to previously occupied sites. If plants return to known sites, monitoring plots should be established to document between year variation in germination and establishment, as well as reproductive success. Studies should be conducted to identify pollinators and pollination success. Additional seeds should be collected and stored for ex-situ conservation and propagation purposes and should be used to grow out plants for seed production, increasing stored seeds available for future population augmentation and introduction purposes. Although habitat is limited, additional habitats in Hidalgo County should continuously be surveyed for possible new or unreported populations. Targeted surveys of the known locations in Mexico are needed to document the current status of the species in Mexico. If extant, understanding habitat requirement of Mexican populations may help to better understand habitats in the United States and therefore help focus restoration and survey efforts.

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