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Pima Pineapple Cactus Restoration: Transplanting and Monitoring

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Introduction

The Pima pineapple cactus (*Coryphantha scheeri* var. *robustispina*) is a small hemispheric cactus endemic to Sonoran desert scrub and semi desert grassland ecosystems in Southern Arizona and a small part of northern Sonora, Mexico. It is most commonly found in low densities growing at 2,500 to 4,500 feet in elevation. Each individual can have one or more stems and does not grow higher than 12 inches. Bright yellow flowers bloom for a single day in the summer and are believed to be primarily pollinated by the ground-dwelling cactus bees (*Diadasia rinconensis*).

In 1993 the Pima pineapple cactus (PPC) was listed as endangered under the Endangered Species Act. Its observed scarcity and potential impacts are key reasons for listing it to be monitored. Anthropogenic sources of impact include urbanization, development, and climate change. Encroachment of non-native species, especially grasses, are of major concern for PPC habitat conservation. This is in addition to other habitat alterations such as sheet erosion and wildfire.

In the United States PPC is only found in Pima and Santa Cruz County, Arizona. Much of the known PPC habitat within Pima County is managed by Pima County. The Pima pineapple cactus is one of 44 species included in Pima County's Multi-species Conservation Plan (and associated Section 10 Permit from the U.S. Fish and Wildlife Service); a comprehensive plan designed to streamline compliance with the Endangered Species Act in return for formalizing certain conservation commitments and mitigation requirements by Pima County. To aid in conservation efforts, PPC seeds were collected from PPC growing on Pima County lands, grown in a nursery, and transplanted into a predetermined area on the same property that the seeds were originally collected from. Continued monitoring can provide further insight into the establishment and survival of this species, specifically that of nursery grown individuals repatriated into wild conditions.

Greenhouse growth, transplanting, and monitoring of PPC will be discussed in this report. This will be in alignment with an overview of the restoration planting project at Canoa Ranch.

Greenhouse Growth

The 31 PPC selected for transplanting at Canoa Ranch were cared for at the Pima County Native Plant Nursery. Previous nursery employees collected seeds from Canoa Ranch and planted them in May 2017. Soil was also collected from this site and mixed with a nursery blend for a growing medium. All seedlings were grown together in a cactus shade house. These structures are designed to allow open air access so humidity and wind could enter, but provide protection

from intense sunlight. They do not allow precipitation through. In summer each pot was watered once every 1.5 weeks and, in the winter, they were watered once a month.

A notable occurrence during the growth of the PPC was the infestation of mealy bugs in the winter of 2021. Many but not all the PPC were affected. The prescribed treatment was to fully submerge the cactus in soap and neem oil for 1 to 5 minutes after removing all of the soil from around the root mass. They were also given bare root treatment. All infected PPC survived with minimal damage but three of them exhibited abnormal growth that may be attributed to stress of the infestation and treatment. The other main stressor was cold stress during the winter months. Cold stress in PPC shows up as discoloration that varies in location, color, and degree. One or two have died over the years due to unknown causes, leaving the nursery grown seeds with a survival rate of about 95%. Blooming among the PPC was observed twice in two separate months of July. The nursery took this opportunity to cross fertilize among the collected seeds.

Transplanting

Choosing the Site

There are several factors in choosing a site for the PPC that will maximize the likelihood of successful establishment. One of the most apparent signifiers of suitable habitat is the presence of existing PPC. While this is a promising feature, the surrounding environment should still be assessed for suitability. A paper by Robert Schmalzel (2000) outlines what to look for when selecting a site to plant PPC. The site should not support dense patches of grasses as they could quickly overwhelm small species by restricting access to nutrients, water, and sunlight. They also contribute to the spread and severity of wildfire. The invasive species buffelgrass (*Pennisetum ciliare*) and Lehmann's lovegrass (*Eragrostis lehmanniana*) are crucial when evaluating PPC habitat. There is a positive correlation between cactus mortality and Lehmann's lovegrass density (Roller and Halvorson 1997). If the cactus is being planted on rangeland with cattle, removal of the cattle could result in greater concentrations of grass. Moving the cattle should only be done if the site is relatively small as there is a greater chance of the cacti being trampled in areas with high densities of cattle concentrated in small areas.

Legal Compliances

Since the Pima Pineapple cactus is a federally protected species under the Endangered Species Act there are necessary legal precautions that must be considered. This cactus is listed under the Multi-species Conservation Plan, which helped to grant a Section 10 (a)(1)(b) permit to Pima County. There is no 'take' for plants under the Endangered Species Act, but the Endangered

Species Act requires compliance with all state laws regarding endangered plant species. Consequently, Arizona state regulations must be followed.

Protection of Arizona's native plants falls under Arizona's Native Plant Law. This law covers five categories of native plant species and protects them from theft, vandalism, or any other unnecessary harm. As an endangered species, the Pima pineapple cactus falls under the category of 'Highly Safeguarded'. Permissions and permits are delegated by the Arizona Department of Agriculture. However, Pima County is a government agency and does not need a permit to salvage or relocate PPC if it's on Pima County-owned property as long as it is on another Pima County property (Native Plant Law, 2008). Pima County's Native Plant Nursery can legally collect and grow seeds from plants growing on Pima County land.

Planting at Canoa Ranch

In September 2022, several staff members of the Office of Sustainability and Conservation and National Resources, Parks and Recreation drove to Canoa Ranch with 31 Pima Pineapple cactuses in various stages of growth. The tools brought to the site include GPS devices, reinforcing bars, shovels, cage material, shade net, wire, and cable shears. A short distance was walked from the vehicle to an area of a known PPC sighting. That PPC was located and appeared to be in good health. Planting of the potted cactuses began nearby. The location chosen for each planting should have very low grass density and be a reasonable distance from mesquite and other large shrub canopies.

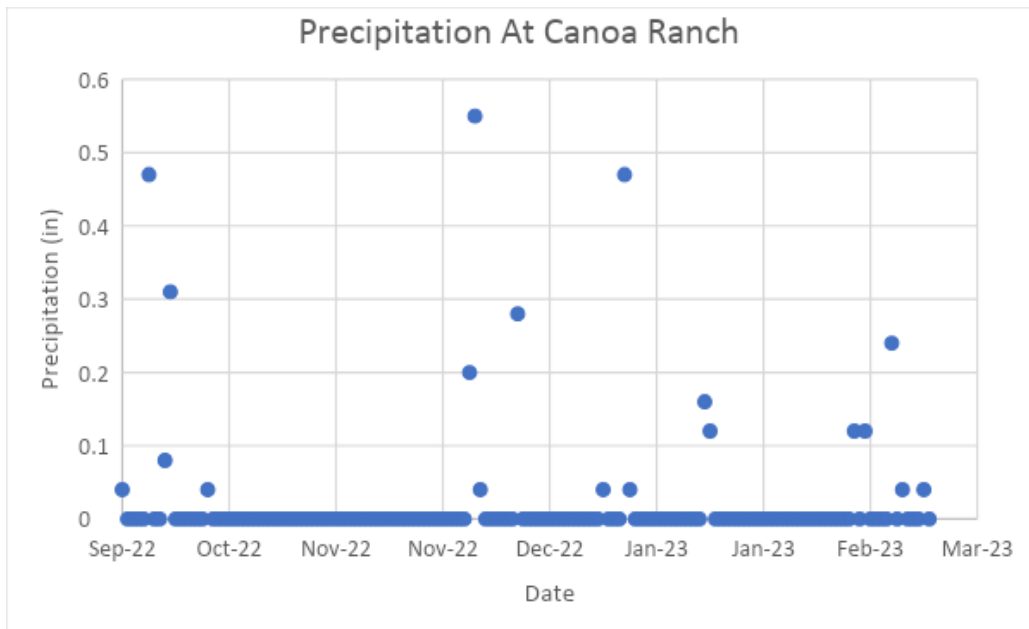
It was advised to the transplanting group to plant shallow, or about the same depth that that the cactus was growing in the pot. Another instruction was to create raised mounds around the base of the cactus. This was to help direct water to the roots while minimizing contact with the base. A later trip to the site revealed that the planting style varied throughout. Some were planted on a flat surface while others were planted in a basin. Most were planted on a mound but some of these were on a mound raised from a basin.

The next task after planting was to secure the PPC from predation and excess sun. In the nursery every PPC was protected from prolonged and harsh sunlight. A small rectangle was cut from the hardware cloth cage material using cable shears and wrapped around two reinforcing bars placed on either side of the PPC. It was then secured by wire and pushed into the dirt. An example of this setup is shown below. All but one of the cages had plant debris propped up inside to provide partial shade to the PPC. Half of the cages were situated with a shade cloth over the top as well. These clothes were secured by wire to the cage.



Monitoring at Canoa Ranch

The transplanted PPC were visited in February 2023 to check on their condition. In the 5 months since planting this area has received a cumulative rainfall depth of 3.39 inches. Figure 2 below represents the daily precipitation in inches at a rainfall gauge located about 3 kilometers from the planting area. Most of the PPC appeared adequately hydrated with some light shriveling on a few.



The most common observable change was a red discoloration varying in hue and extent for almost all the PPC. This was mostly found on the tips of the tubercles. Slight yellow, purple, and/or orange discoloration could also be seen on at least 8 individuals. The main cause of the red discoloration is a stress response, likely due to freezing temperatures. This is often seen in wild growing cacti. Being transplanted into a natural environment after growing in a controlled greenhouse would exacerbate stress as well.

Monitoring and Recommendations

MSCP Goals

Under Pima County's Multi-species Conservation Plan, PPC on county land is monitored to detect biologically meaningful changes in PPC populations and to contribute towards species recovery. The plan was created to remain in compliance with Pima County's Section 10 incidental take permit issued by the U.S. Fish and Wildlife Service. The PPC monitoring program is focused on collecting wild PPC population trends over the 30-year duration of the Multi-species Conservation Plan. Outplanting of the nursery grown PPC is directed at providing data on how this species can be conserved through transplanting.

Monitoring of transplanted Pima pineapple cactus

In a study conducted by Berthelette (2017) it was found that deaths of 82 transplanted PPC did not begin until at least 8 months after planting. Most of these deaths occurred after several months of declining health and only six were believed to die suddenly.

Watering Recommendations

Having been on a consistent watering regimen prior to transplanting, each cactus should be properly watered to ensure the best chances of survival. After transplanting the soil around the cactus should be slightly damp. As the transplanting crew finished up the last pots at Canoa Ranch it began to lightly rain over the site; this eliminated the need to water right away. As a succulent, the Pima pineapple cactus is equipped to store water in between wet and dry periods. During the winter, cooler temperatures lead to a decreased need for water. Unless the season is unusually dry, transplanted PPC will likely not need to be watered. Supplemental watering may be required during prolonged heat in the summer months. Still, it is important that the soil surrounding the cactus does not remain overly moist for too long. This could lead to root rot and stress.

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