Conservation introduction of Bakersfield cactus in the southern San Joaquin Valley, California, USA

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Introduction

Bakersfield cactus (*Opuntia basilaris var. treleasei*) is a perennial stem succulent in the cactus family (Cactaceae) and is endemic to Kern County in central California, USA. Bakersfield cactus occurs on floodplains, low rolling hills, ridges, and bluffs (USFWS, 1998). Soils commonly are well-drained and are sandy or gravelly with little silt, clay, or organic matter, and may contain cobbles or boulders. Plant communities include chenopod scrub, grasslands, and dry oak woodlands (USFWS, 1998 & 2011). Many sites with Bakersfield cactus have been converted to agricultural and urban uses and petroleum production. Approximately one-third of known populations have been extirpated; the remaining populations are fragmented and generally occur on small parcels (Cypher *et al.*, 2011b). Populations continue to be lost, and habitat conditions are being degraded for some remaining populations. Consequently, the taxon is listed as Federal and California Endangered. This taxon currently has no IUCN status.

The establishment of additional populations could contribute significantly to the conservation and ultimate recovery of Bakersfield cactus. Translocation and introduction is a potential strategy for establishing new populations for this species. We attempted two experimental translocations using shed pads and small plants in an effort to establish new populations in suitable but unoccupied habitat.

Cactus in native habitat showing threats from non-native grass and agricultural conversion

Co-authors translocating a Bakersfield cactus plant

Goals

- Goal 1: Establish new populations of Bakersfield cactus in suitable but unoccupied habitat.
- Goal 2: Evaluate methods for effectively translocating and establishing Bakersfield cactus.

Success Indicators

- Indicator 1: Rooting and survival of translocated cactus pads for at least 2 years.
- Indicator 2: Survival of translocated plants for at least 2 years.
- Indicator 3: Growth and survival of new pads on translocated pads and plants.
- Indicator 4: Development of guidelines and procedures for future translocation efforts.

Project Summary

Feasibility: Feasibility issues for this project included biological, environmental and socio-political considerations. Biological feasibility was deemed to be high. Translocation, particularly of pads (i.e., stem segments, cladodes), was considered to have a high probability of success because Bakersfield cactus, typical of many cacti, easily reproduces vegetatively through the shedding and rooting of pads. Furthermore, pads and plants were going to be planted in optimal microsites in that the site would be cleared of competitors (Cypher & Fiehler, 2006), the soil bed would be loosened to facilitate moisture penetration and root development, and solid ground contact would be ensured to further facilitate rooting. Finally, Bakersfield cactus had been translocated successfully previously, although in small numbers.

Environmental feasibility was also deemed to be high because the two introduction sites chosen were located within the historic range of Bakersfield cactus, and indeed, were only approximately 500 m and 100 m, respectively, from existing cactus populations. Topography and soils at both sites were consistent with conditions occurring within existing populations. Bakersfield cactus is absent from numerous locations with apparently suitable conditions, probably due to past disturbances (now mitigated) or dispersal limitations (e.g. movement uphill is probably rare). Thus, the potential for the remaining habitat to support more populations is high.

Socio-political considerations may present the greatest challenge to feasibility. In general, there is considerable resistance in the region to expanding the

distribution of Bakersfield cactus, or any other rare species, due to regulatory restrictions concomitant with the presence of such species. Thus, the potential for establishing new populations is limited to lands and landowners dedicated to the protection of natural resources. Also, the agencies overseeing endangered species conservation further restrict any translocations to lands that will be legally conserved in perpetuity. Despite these restrictions, a number of sites in the region meet all the criteria above (e.g., suitable habitat, permanent protection, willing landowners) and potentially are available for the establishment of cactus populations.

Implementation: Bakersfield cactus pads and plants were collected from a population approximately 4.5 km and 2.5 km, respectively, from the two introduction sites. For the first effort conducted in October 2009 (Cypher *et al.*, 2011a), 10 small plants and 25 shed pads were collected from a protected portion of the source population. For the second effort conducted in January 2011, pads and partial plants were collected from an unprotected portion of the source population that was undergoing active conversion to citrus orchards. At the introduction sites, all vegetation was cleared from a 0.25 m^2 area for each pad or plant. The soil at the site was loosened to a depth of ca. 20 cm - 30 cm. In both efforts, plants were installed by hand-digging a small excavation and then installing the plant and filling the hole with local soil. In the first effort, pads were laid horizontally (flat side down) at each planting site and secured with a wooden skewer. In the second effort, the pads were partially buried in the soil in one of three orientations: horizontal, vertical (upright), or on edge. All pads and plants were then thoroughly watered

Issues considered included precipitation, competition, and cattle. The region is arid and precipitation is unpredictable. On average, the region receives ca. 16 cm of precipitation annually. Therefore, we occasionally provided supplemental water to plants at each site as we deemed necessary. The first site was watered two times before soil moisture from natural precipitation was deemed sufficient. The second site was watered two times, including one during the summer following planting. In addition to clearing vegetation prior to planting, we also hand-pulled vegetation from around cactus plants during the first year to reduce competition for soil moisture. To prevent injury

Cactus under cattle guard - note flower bud, new pads and non-native grass competitors

to plants from cattle, we inserted two bent steel bars over plants to discourage trampling by cows.

Post-planting monitoring: At both introduction sites, success was monitored by visiting each site periodically and determining whether plants were still alive, and whether any flowering or vegetative reproduction had occurred. At the first site, nine of the 10 translocated plants were still alive (90% survival) after 34 months. However, only four of the 25 translocated pads were still alive (16% survival). The four pads that survived were among the heavier pads translocated. Some plants had flowered, and at least two plants had shed pads that subsequently rooted. Some cattle damage was noted, but only on plants that had not been protected with the steel bars. At the second introduction site, 100% of translocated plants were still alive after 25 months and several had flowered. Among partially buried pads, those with a vertical orientation had higher survival rates (mean 89%), than those laid horizontally (63%) or on edge (60%).

Major difficulties faced

- Agency restrictions on size and quantity of cactus removed from the source population.
- Plants with many pads disarticulated during transport or planting.
- Survival of transplants, especially pads, during the dry summer season.
- Invasive plants colonizing the cleared bedding areas.

Major lessons learned

- Small plants are preferable to pads for translocation. Plants that are too large disarticulate during the process, and pads have lower survival rates.
- Pads should be placed upright in pots and allowed to develop roots prior to outplanting. This has been successfully implemented by a local preserve that learned from our effort, and five new populations of Bakersfield cactus have been established at the preserve.
- Larger, heavier pads tend to grow faster and have higher survival rates.
- Control of competitors is essential, both before and after transplanting.
- Watering during the first one or two summers increases survival rates.

Success of project

Highly Successful	Successful	Partially Successful	Failure
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Reason(s) for success/failure:

- Anticipating and addressing many of the potential difficulties prior to implementation.
- Relative ease of propagating succulents compared to herbaceous or woody plants.

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