

Bunched Cory Cactus Five-Year Review - Final

**Bunched Cory Cactus**  
*Coryphantha ramillosa* Cutak ssp. *ramillosa*

**5-Year Review:**  
**Summary and Evaluation**



**U.S. Fish and Wildlife Service**  
**Austin Ecological Services Field Office**  
**Austin, Texas**

**5-YEAR REVIEW**  
**Bunched Cory Cactus / *Coryphantha ramillosa* Cutak ssp. *ramillosa***

**1.0 GENERAL INFORMATION.**

**1.1 Reviewers.**

Lead Regional Office: Southwest (Region 2).  
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**1.2 Methodology used to complete the review:**

This review considers both new and previously existing information from Federal and State agencies, non-governmental organizations, academia, and the general public. Information used in the preparation of the review include the Texas Parks and Wildlife Department (TPWD) Natural Diversity Database (TXNDD), final reports of Section 6-funded projects, monitoring reports, scientific publications, unpublished documents, personal communications from botanists familiar with the species, and Internet web sites. This 5-year review was prepared without peer review by personnel of the Austin Ecological Services Field Office.

**1.3 Background:**

U.S. Fish and Wildlife Service (USFWS) listed bunched cory cactus as threatened without critical habitat on November 6, 1979. The State of Texas listed bunched cory cactus as threatened on April 29, 1983. The Mexican federal government listed the species as threatened (Secretaría de Medio Ambiente y Recursos Naturales 2010, p. 55).

The first use of technical terms and words with arcane meanings in the lexicons of science and government are underlined, and are defined in the glossary on pages 31-35. For convenience, the first uses of scientific units are spelled out, and are also summarized on page 30. Photographic credits are on page 30. This is the first status review since the species was listed (1979) and the recovery plan was prepared (1989). For convenience, we include brief summaries under each topic of the information known at those times.

Recommended citation:

U.S. Fish and Wildlife Service. 2018. Bunched cory cactus (*Coryphantha ramillosa* Cutak ssp. *ramillosa*) five-year review: Summary and evaluation. Austin Ecological Services Field Office, Austin, Texas. 36 pp.

**1.3.1 Federal register citation announcing initiation of this review:** February 11, 2009 (74 FR 6917) and May 31, 2018 (83 FR 25034).

**1.3.2 Listing history.**

Original Listing

Federal Register notice: 44 FR 64247.

Date listed: November 6, 1979.

Entities listed: *Coryphantha ramillosa* (bunched cory cactus).

Classification: Threatened; Critical Habitat was not designated.

Critical Habitat Designation: n/a

**1.3.3 Associated rulemakings: n/a**

**1.3.4. Review History.**

No previous 5-year review has been conducted for bunched cory cactus. Other review documents include:

Status Report on *Coryphantha ramillosa* (Weniger 1979).

**1.3.5 Species' Recovery Priority Number at start of 5-year review:**

Prior to this review, the Recovery Priority Number for bunched cory cactus was 8. This indicates that the degree of threat was moderate, the recovery potential was high, the taxon was a species, and no conflicts with construction, development projects, or other forms of economic activity were foreseen.

**1.3.6 Recovery Plan or Outline.**

Name of plan or outline: Bunched Cory Cactus (*Coryphantha ramillosa*) Recovery Plan.

Date issued: April 13, 1990.

Dates of previous revisions, if applicable: n/a

**2.0 REVIEW ANALYSIS.**

**2.1 Application of the 1996 Distinct Population Segment (DPS) policy.**

The Distinct Population Segment policy applies only to vertebrate animals.

**2.2 Recovery Criteria.**

**2.2.1 Does this species have a final, approved recovery plan?**

Yes.

**2.2.1.1 Does the recovery plan contain objective, measurable criteria?**

Yes.

**2.2.2 Adequacy of recovery criteria.**

**2.2.2.1 Do the recovery criteria reflect the best available and most up-to-date information on the biology of the species and its habitat?**

The recovery criteria should be revised, as discussed in Sections 2.2.3 and 2.3.1.3, in accordance with the revised recovery planning guidance (USFWS 2017a).

**2.2.3 List the recovery criteria as they appear in the recovery plan, and discuss how each criterion has or has not been met, citing information:**

Recovery Plan Criteria

*The criteria for delisting the bunched cory cactus will be to identify at least three sites where the species can be protected and then carry out protective management measures. One site should be on private land in northeastern Brewster or southwestern Terrell County, one site should be in Big Bend National Park, and one site should be in Mexico. Each site should initially contain at least 500 plants and should have enough available habitat to permit population expansion and growth. The species can be delisted when monitoring and habitat surveys indicate that a total of at least 10,000 plants is being sustained at the protected and managed sites.*

Section II (pp. 14-15) lists 4 actions, also referred to as criteria:

- 1. Develop and implement management measures that will ensure the continued protection of at least three sites where populations occur. The three sites should represent the full geographic range of the species, which means one site should be on private land in northeastern Brewster or southwestern Terrell County, one site should be in Big Bend National Park, and one site should be in Mexico. Each site should initially contain at*

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*least 500 plants, and should have adequate suitable habitat to allow for population expansion and growth.*

- 2. Develop and implement cooperative law enforcement strategies to provide protection against illegal collecting both on public and on private lands.*
- 3. Search potential habitat and accurately determine population locations, area occupied, and number of plants.*
- 4. Establish permanent monitoring plots to determine population changes. The plots should be censused at least annually.*

*Actions necessary for delisting include:*

- 1. Identifying at least three sites (using the criteria on the previous page) where the species will be protected.*
- 2. Carrying out management measures that are determined to be necessary for continued protection of the three sites and for protection of the species and its habitat in general.*
- 3. Demonstrating long-term stability or increase in population levels and habitat through monitoring and habitat surveys. A total of 10,000 plants at protected and managed sites must be sustained.*

*These criteria will be evaluated for adequacy upon attainment and prior to delisting.*

### Discussion

The recovery plan confounds recovery criteria, recovery objectives, and recovery actions. We interpret the intended criteria to be: 1) Protection, appropriate management, and monitoring of bunched cory cactus populations in three areas (Big Bend National Park (BIBE), private land in eastern Brewster and Terrell counties, and unspecified land in Coahuila); 2) a minimum population (or metapopulation) size of 500 at each protected area; 3) a total population at the three protected areas of 10,000 individuals; and 4) demonstrated stable or improving demographic trends at each protected site over an unspecified period of time.

Currently only one area is protected and managed, at BIBE. Although the population size was estimated in the 1980s to have 800 to 900 individuals, a census in 2004 detected only 256 individuals.

An estimate of the population size on private land in Terrell County exceeded 10,000 individuals (Schmalzel et al. 1999, pp. 15-16). However, this was based on a single, un-replicated sample, so it is difficult to judge the accuracy of this estimate. None of the populations can be considered protected, managed sites.

We have no information on population sizes, protection, or management in Coahuila.

## 2.3 Updated Information and Current Species Status

### 2.3.1 Biology and Habitat

#### 2.3.1.1 Description, taxonomic classification and phylogenetics:

##### Summary of prior information.

A.R. Davis, of Marathon, Texas, first observed bunched cory cactus at the head of Reagan Canyon in 1936. Cutak (1942) described *Coryphantha ramillosa* based on specimens Davis collected in 1939 (A.R. Davis s.n., MO #12L12260). Weniger (1970) published the species invalidly as *Mammillaria ramillosa* (USFWS 1989, p. 3). The longer, curving, twisting spines and purplish flowers of *C. ramillosa* distinguished it from the yellow-flowered *C. scheeri* and *C. scolymoides* (Weniger 1979, p. 2). *C. ramillosa* has flattened, overlapping tubercles, relatively few stems, sulca extending from the apex to the base of the tubercles, entire outer perianth segments, and ovoid fruits less than 2 cm long, while *C. macromeris* has cylindrical, widely-spaced tubercles, large numbers of stems, sulca extending only half of the tubercle length, frilled outer perianth segments, and elongate fruits over 3 cm long (Weniger 1979, p. 2; Heil *et al.* 1985, p. 29).

Table 1. Distinguishing features of bunched cory cactus (Cutak 1942, p. 166; Weniger 1979, pp. 1-2; Benson 1982, p. 835; Heil *et al.* 1985 p. 29; Anderson 2001, p. 195; Dicht and Lüthy 2005, p. 167; Poole *et al.* 2007, pp. 160-161; Powell *et al.* 2008, pp. 333-334).

Feature	Description
Stems	Solitary to clustered, globular to ovoid, depressed, gray-green, white wool at apex, 3-8 centimeters (cm) (1.2-3.1 inches (in)) tall, 6-9 cm (2.4-3.5 in) broad.
Ribs	Tubercles not arranged in distinct ribs.
Tubercles	± 2 cm (0.8 in) long by 15-25 mm (0.6-1.0 in) wide, base broad, sulca from apex to base, flattened, overlapping, and imbricated.
Areoles	Circular, ± 3 mm (0.12 in) diameter and 12 mm (0.47 in) apart, becoming linear, tomentose initially, later glabrate.
Central spines	4, 25-38 mm long, dark brown initially, later gray-brown with darker tips, lowest prostrate or curved downward, upper 3 straight or curved, ascending.
Radial spines	14-20, 10-35 mm (0.39-1.38 in) long, whitish or gray, spreading, flattened or angled, slightly curving and twisting.
Flowers	± 65 mm (2.4 in) long by 50 mm (1.97 in) wide; pale pink to deep rose-purple, inner perianth segments lighter in color, broader, with light green dorsal midstripe; flower tube with light green scales becoming purplish near the outer perianth; filaments 7-8 mm (0.27-0.31 in) long, white, attached to the tube, upper filaments reaching the bases of stigma lobes; pollen golden-yellow to orange; style ± 18 mm (0.71 in) long, white, stigma lobes 6-7, 4-7 mm (0.16-0.27 in) long; ovary whitish.
Fruit	Ovoid, 1.5-2.5 cm (0.59-0.98 in) long, 1.2-1.6 cm (0.47-0.63 in) wide, dark green to gray green with white hair-like scales, juicy pulp.

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Feature	Description
Seeds	1-1.5 mm (0.04-0.06 in) long, reddish-brown to golden-brown, surface finely <u>reticulate</u> .

New information.

Zimmerman’s doctoral dissertation on the systematics of the genus *Coryphantha* included 67 species and 25 varieties in 4 subgenera (Zimmerman 1985, p. 173; although completed prior to the recovery plan, this dissertation was not yet publicly available). He recognized *Coryphantha ramillosa* as a valid species in subgenus *Coryphatha* (p. 182). Weedon *et al.* (1989, p. 161) reported that, like most Cactaceae, *C. ramillosa* is diploid (2n = 22).

Dicht and Lüthy (2005, p. 43) described the following diagnostic characteristics of the genus in their monograph on *Coryphantha*: The capacity to produce extrafloral nectaries; grooved flower-bearing tubercles; flowers arising from the stem apex; fruits green and moist at maturity; and brown seeds with a reticulate testa. They placed *C. ramillosa* within Subgenus *Coryphantha*, Section *Coryphantha*, Series *Corniferae*, and Subseries *Delaetienae* (pp. 37-38). These authors described subspecies *santarosa* of *C. ramillosa* based on G.B. Hinton specimen 25792 from La Babia, northwest of Múzquiz, Coahuila (Dicht and Lüthy 2000, p. 141); consequently, the original species—the entity that was listed as threatened—is now *C. ramillosa* subspecies *ramillosa*. Subspecies *santarosa* is distinguished from subspecies *ramillosa* by its yellow perianth segments, fewer radial spines, shorter radial and central spines, smaller tubercles, and shorter stems (Dicht and Lüthy 2005, pp. 167-168). Dicht and Lüthy observed wild populations of subspecies *santarosa* between San Alberto (60 km NE of Monclova), Piedras Negras, and Boquillas del Carmen, Coahuila, with the densest populations in the Sierra Hermosa de Santa Rosa. Another specimen of subspecies *santarosa* (G.B. Hinton 28271) was reported from El Salitre, Hidalgo, Nuevo León (Tropicos 2018); however, the geographic coordinates indicated appear incorrect.

Individuals of some populations of *C. ramillosa* ssp. *ramillosa* in Coahuila frequently have 20 to 25 stems—as suggested by the epithet *ramillosa*, “many branches”—while most individuals in Texas have a single stem (Powell *et al.* 2008, p. 334).

Table 2. Taxonomic classifications of bunched cory cactus.

Classifications	Citations
<i>Coryphantha ramillosa</i>	Cutak 1942; Benson 1982, p. 835; Zimmerman 1985, p. 182; Anderson 2001, p. 195; Zimmerman and Parfitt 2004 a, b; Natural Resources Conservation Service 2018.
<i>Mamillaria ramillosa</i>	Weniger 1970.
<i>Coryphantha ramillosa</i> ssp. <i>ramillosa</i>	Dicht and Lüthy 2005, p. 167; Integrated Taxonomic Information Service 2018; Tropicos 2018.

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Figure 1. Photographic images of bunched cory cactus.



1a, b: Habitat. 1c. Flower.  
1d: Mature plant.  
1e: Adaptation to crevices.



### **2.3.1.2 New information on the species' biology, life history, habitat, and ecosystem:**

Summary of prior information (Weniger 1970, pp. 3-4; Heil et al. 1985, pp. 29-31; USFWS 1989, pp. 5-7).

Bunched cory cactus grows in excessively fractured limestone of the Boquillas and Santa Elena formations in association with typical vegetation of the Chihuahuan Desert scrubland (see Figures 1a, b, d, and e and Table 3). Elevations range from 400 to 1,150 m (1,312 to 3,773 ft) on slopes and summits of canyons of the Rio Grande/Bravo and its tributaries, as well as hilly terrain in Coahuila. Annual precipitation is about 25 to 30 cm (10 to 12 inches) per year. Individuals become sexually mature at about 5 years of age. Flowering occurs most often from July to August, in response to monsoonal rainfall, or as early as April. Flowers open in the mid-afternoon and last from 3 to 14 days. Green Halictid bees are major pollinators. Fruits mature from August to December and have about 75 seeds each that are dispersed by ants and rodents. Seeds germinate well in fissures and among flakes of limestone.

#### New information.

#### Phenology, growth, and reproduction.

Although the breeding system of bunched cory cactus has not been documented, Zimmerman (1985, p. 137) stated that most *Coryphantha* species are obligate outcrossers.

Schmalzel *et al.* (1999, p. 20) learned from local observers who were familiar with bunched cory cactus that it flowers from mid-September to October, following rain; the flowers open for 2 or 3 days; populations can flower more than once per season; fruits mature in about 6 to 8 weeks; and fruits persist 1 to 2 months. Stems expand and contract according to the amount of water they contain, confounding direct growth measurements. Consequently, Schmalzel *et al.* (1999, p. 33) estimated growth by painting the spine clusters of young tubercles and observing tubercle production at intervals for two years. They observed that flowers arose only from tubercles produced during the same season. Based on their estimates of size-age relationships, plants become reproductive at about 9 years, corresponding to a diameter of 40 mm (p. 35). They were unable to observe pollinators, seed dispersal, or seedling recruitment (p. 37).

#### Habitat.

Schmalzel *et al.* (1999) investigated bunched cory cactus populations at BIBE as well as 17 new sites on private properties in Brewster and Terrell counties. In addition to the Boquillas and Santa Elena formations, in some canyons most plants were on Buda limestone (p. 14). The vegetative cover of populated sites ranged from 5 to 50 percent, but bunched cory cactuses occupied patches with the least cover and were in full or partial sunlight (pp. 15, 30).

Schmidt (2017) constructed predictive models for bunched cory cactus distribution using the geographic coordinates and data from a census conducted by personnel of BIBE in 2004. The census documented 256 individuals, and Schmidt found 10 new individuals in March 2017 (p. 14). The average parameters for all known individuals at the park are 595 m (1,953 ft) elevation,

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slope of 6.7°, 25.4 cm (10.0 in) of annual precipitation, and average maximum and minimum temperatures of 30.56° and 12.22° Celsius (C) (87.0° and 54.0° Fahrenheit (F)), respectively (p. 14). Seven site variables significantly predicted individual distribution: slope, aspect, land cover, percent canopy cover (see vegetative cover), geological substrate, soil map unit, and soil type (p. 14). The probability was higher at steeper slopes up to 50°, and higher at southeast- and south-facing slopes (pp. 14-15). Individuals were more likely to occur in barren land than on scrubland and in the lowest canopy cover class of 0 to 15 percent. The probability was higher on limestones than on alluvium, and highest on the Blackgap-rock outcrop complex, which is classified as a Lithic Ustic Torriorthent.

We used some of the variables identified by Schmidt and others to estimate the amount and distribution of potential habitat using ArcGIS software. We used USGS Digital Elevation Models to create a geographic layer of areas ranging from 400 to 1,100 m (1,312 to 3,609 ft), the known elevation range of bunched cory cactus populations (the Terrell County sites documented by Schmalzel *et al.* (1999) occur at lower elevations than previously reported for this species). We created two additional geographic layers consisting of the occupied soil map units, obtained from NRCS SSURGO web soil survey data sets (NRCS 2017), and the occupied geological formations (Stoeser *et al.*, 2005). The soil map units are the Blackgap-rock outcrop complex (20-70 percent slopes) and the Mariscal rock outcrop complex in Brewster County, and the Ector-rock outcrop association (1-15 percent slopes) and Ector-rock outcrop complex (10-60 percent slopes) in Terrell County. We based our selection of occupied soil map units in Terrell County by overlaying the geographic coordinates reported by Schmalzel *et al.* (1999) on the web soil survey in ArcGIS. The geological formations are the Buda, Boquillas, and Santa Elena limestones. The intersection of these three layers represents potential habitats in Brewster and Terrell counties, totaling 151,022 hectares (ha) (379,175 acres (ac)) (shown in Figure 3). This yields a fairly broad provisional estimate of potential habitats, but is geographically more restrictive than a model shown in a conference poster by Fritsch and Amos (2015). As we learn more about the species' ecological requirements, this estimate could be refined.

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Table 3. Plant species associated with bunched cory cactus.

Family	Genus	Species	Common Name	Heil, Brack, and Porter 1985	USFWS 1989	Schmalzel et al. 1999	Schmidt 2017
Asparagaceae	<i>Agave</i>	<i>lechuguilla</i>	Lechuguilla	x	x	x	x
Asparagaceae	<i>Yucca</i>	<i>elata</i>	Soaptree Yucca			x	
Asparagaceae	<i>Yucca</i>	<i>torreyi</i>	Torrey Yucca			x	
Asteraceae	<i>Bahia</i>	<i>absinthifolia</i>	Whiteleaf Bahia			x	
Asteraceae	<i>Thymophylla</i>	<i>pentachaeta</i>	Fiveneedle dogweed			x	
Asteraceae	<i>Thymophylla</i>	sp.	Dogweed			x	
Boraginaceae	<i>Heliotropium</i>	sp.				x	
Boraginaceae	<i>Tiquilia</i>	sp.				x	
Bromeliaceae	<i>Hechtia</i>	<i>texensis</i>	Texas false agave			x	
Cactaceae	<i>Ariocarpus</i>	<i>fissuratus</i>	Living rock cactus	x	x	x	x
Cactaceae	<i>Coryphantha</i>	<i>echinus</i>	Sea urchin cactus	x	x	x	x
Cactaceae	<i>Coryphantha</i>	<i>macromeris</i>	Beehive cactus				x
Cactaceae	<i>Coryphantha</i>	<i>pottsii</i>	Runyon's pincushion cactus			x	
Cactaceae	<i>Coryphantha</i>	sp.				x	
Cactaceae	<i>Cylindropuntia</i>	<i>imbricata</i>	Tree cholla	x	x		x
Cactaceae	<i>Cylindropuntia</i>	<i>imbricata</i> var. <i>argentea</i>				x	
Cactaceae	<i>Cylindropuntia</i>	<i>leptocaulis</i>	Tasajillo	x	x	x	x
Cactaceae	<i>Echinocactus</i>	<i>horizonthalonius</i>	Eagle Claw	x	x	x	x
Cactaceae	<i>Echinocereus</i>	<i>dasyacanthus</i>	Texas rainbow cactus	x		x	
Cactaceae	<i>Echinocereus</i>	<i>Pectinatus</i> var. <i>wenigeri</i>	Langtry rainbow cactus		x		
Cactaceae	<i>Echinocereus</i>	<i>stramineus</i>	Strawberry Hedgehog cactus	x	x	x	x
Cactaceae	<i>Escobaria</i>	<i>duncanii</i>	Duncan's pincushion cactus	x	x		x
Cactaceae	<i>Escobaria</i>	<i>tuberculosa</i>	Cob cactus	x		x	
Cactaceae	<i>Ferocactus</i>	<i>hamatacanthus</i>	Turk's-head barrel cactus	x	x	x	x

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Family	Genus	Species	Common Name	Heil, Brack, and Porter 1985	USFWS 1989	Schmalzel et al. 1999	Schmidt 2017
Cactaceae	<i>Glandulicactus</i>	<i>uncinatus</i> var. <i>wrightii</i>	Eagle Claw Cactus			x	
Cactaceae	<i>Grusonia</i>	<i>schottii</i>	Dog cholla	x		x	x
Cactaceae	<i>Mammillaria</i>	<i>lasiacantha</i>	Golf ball pincushion cactus	x	x	x	x
Cactaceae	<i>Opuntia</i>	<i>azurea</i> var. <i>aureispina</i>	Golden-spined Prickly Pear			x	
Cactaceae	<i>Opuntia</i>	<i>engelmannii</i>	Engelmann prickly pear	x			x
Cactaceae	<i>Opuntia</i>	<i>macrocentra</i>	Purple prickly pear	x		x	
Cactaceae	<i>Opuntia</i>	<i>phaeacantha</i>	Brown-spined prickly pear			x	
Cactaceae	<i>Opuntia</i>	<i>phaeacantha</i> var. <i>brunnea</i>		x			
Cactaceae	<i>Opuntia</i>	<i>phaeacantha</i> var. <i>discata</i>			x		
Cactaceae	<i>Opuntia</i>	<i>rufida</i>	Blind prickly pear	x		x	x
Cactaceae	<i>Opuntia</i>	<i>sp. nov.</i>		x			
Cactaceae	<i>Opuntia</i>	<i>X spinosibacca</i>	Spiny fruited prickly pear			x	
Cactaceae	<i>Sclerocactus</i>	<i>warnockii</i>	Warnock's cactus	x	x	x	x
Ebenaceae	<i>Diospyros</i>	<i>texana</i>	Chapote			x	
Euphorbiaceae	<i>Euphorbia</i>	<i>antisyphilitica</i>	Candelilla	x	x	x	x
Euphorbiaceae	<i>Jatropha</i>	<i>dioica</i>	Leather Stem	x	x	x	x
Fabaceae	<i>Acacia</i>	<i>constricta</i>	Whitethorn Acacia	x	x		x
Fabaceae	<i>Acacia</i>	<i>schottii</i>	Schott's Acacia			x	
Fabaceae	<i>Acacia</i>	sp.				x	
Fouquieriaceae	<i>Fouquieria</i>	<i>splendens</i>	Ocotillo	x	x	x	x
Hydrophyllaceae	<i>Nama</i>	sp.				x	
Krameriaceae	<i>Krameria</i>	<i>erecta</i>	Pima rattany	x	x		x
Krameriaceae	<i>Krameria</i>	<i>grayii</i>	White rattany			x	
Linaceae	<i>Linum</i>	sp.				x	

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Family	Genus	Species	Common Name	Heil, Brack, and Porter 1985	USFWS 1989	Schmalzel et al. 1999	Schmidt 2017
Loasaceae	<i>Eucnide</i>	<i>bartonioides</i>	Yellow Stingbush			x	
Nyctaginaceae	<i>Allionia</i>	<i>incarnata</i>	Trailing windmills			x	
Nyctaginaceae	<i>Selinocarpus</i>	<i>angustifolius</i>	Narrowleaf moonpod			x	
Oleaceae	<i>Forestiera</i>	sp.				x	
Oleaceae	<i>Menodora</i>	<i>scoparia</i>	Rough Menodroa			x	
Poaceae	<i>Aristida</i>	sp.	Three-awn			x	
Poaceae	<i>Bouteloua</i>	<i>brevisetata</i>	Gypsum grama	x	x		
Poaceae	<i>Bouteloua</i>	<i>ramosa</i>	Chino grama			x	
Poaceae	<i>Dasyochloa</i>	<i>pulchella</i>	Fluffgrass			x	
Poaceae	<i>Lycurus</i>	<i>phleoides</i>	Common Wolfstail			x	
Poaceae	<i>Pappophorum</i>	<i>vaginatum</i>	Whiplash Pappusgrass			x	
Polygalaceae	<i>Polygala</i>	sp.				x	
Rhamnaceae	<i>Karwinskia</i>	<i>humboldtiana</i>	Coyotillo			x	
Scrophulariaceae	<i>Leucophyllum</i>	<i>candidum</i>	Barometer Bush	x	x	x	
Scrophulariaceae	<i>Leucophyllum</i>	sp.				x	
Selaginellaceae	<i>Selaginella</i>	<i>lepidophylla</i>	Resurrection plant			x	x
Selaginellaceae	<i>Selaginella</i>	sp.	Resurrection plant	x	x		
Verbenaceae	<i>Glandularia</i>	<i>pumila</i>	Pink mock vervain			x	
Verbenaceae	<i>Lippia</i>	<i>graveolens</i>	Wild oregano			x	
Zygophyllaceae	<i>Larrea</i>	<i>tridentata</i>	Creosote bush	x	x	x	x

### **2.3.1.3 Trends in abundance, number and spatial distribution of populations, and demographic trends.**

Summary of prior information (Weniger 1979, p. 3; Heil et al. 1985, p. 29; USFWS 1989, pp. 3-6, 8).

Bunched cory cactus ranges from southeastern Brewster and Terrell counties southward to central Coahuila, with one disjunct population in BIBE (see Figures 2 and 3). Populated sites are widely scattered, and most sites are on private land. The total population size had not been quantified, but one estimate ranged from 5,000 to 10,000 individuals.

On March 11-12, 1986, five students and the instructor of Earlham College Southwest Field Studies (1986) conducted a census of two colonies of the population at BIBE. Individual bunched cory cactuses along two transects had from 1 to 15 stems that averaged from 27.5 to 37.8 mm (1.1 to 1.5 in) tall; the tallest stem was 110 mm (4.3 in). They counted 315 and 42 stems on two ridges, and stated that similar numbers occurred on nearby ridges. The population appeared healthy. M. Fleming (cited in USFWS 1989, p. 6) estimated that 800 to 900 individuals were scattered over an area of 25 x 1,000 m (82 x 3,208 ft).

#### New Information.

##### Range and abundance.

Schmalzel *et al.* 1999 obtained permission to conduct surveys of private ranches in Terrell County with the help of Mr. Jim Talbot, a resident of Sanderson, Texas. They confirmed 17 new population sites; Talbot reported three additional sites that the investigators were not able to verify (pp. 21-28). They found 228 bunched cory cactus individuals along 2 km (1.24 mi) of Red House Canyon. Assuming that this density is representative of all populated sites, they estimated the total population would be 10,260 over a span of 90 km in Red House, Lion, Sanderson, Cook, Isinglass, Washboard, and Cedar canyons, and one unnamed canyon (pp. 15-16). Since other populations occur at Reagan, Big, and Rio Grande canyons, as well as a mesa near Seminole Canyon, 10,000 is a conservative estimate of the U.S. population within 30 km (18.6 mi) of the mouth of Sanderson Canyon (p. 16). However, in contradiction of earlier reports by Weniger (1979, pp. 5,7), the species has never been documented at Black Gap Wildlife Management Area (BGWMA) (Bonnie McKinney, cited in Schmalzel *et al.* 1999, pp. 27-28), and surveys of Maravillas Canyon (BGWMA) and Mariscal Mountain (BBNP) by Schmalzel's team did not detect bunched cory cactus. They concluded that bunched cory cactus is not rare and should not be listed as threatened under ESA (p. 39).

Anderson (2001, p. 195) also stated that *Coryphantha ramillosa* is more widespread than previously thought and may not be threatened throughout its range.

Dicht and Lüthy (2005, p 167) indicated that the range of *Coryphantha ramillosa* extends to Chihuahua near the Rio Grande; the populations in north-central Coahuila are subspecies *santarosa* (see Figure 2).

## Demography.

Over a 2-year period, Schmalzel *et al.* (1999) tracked growth, reproductive output, and mortality of the colonies at BIBE that were previously surveyed by the Earlham College class, described above. By means of the age-and-tubercle number correlation (described in Section 2.3.1.2) they estimated that individuals reach a 40-tubercle size in 10 and 12 years in years of average and below-average rainfall, respectively (p. 17). However, this method may have underestimated age (p. 34). The average and range of stem tubercle numbers were  $26.8 \pm 9.6$  (9 to 53;  $n = 120$ ), corresponding to an average age of  $7.17 \pm 2.45$  years. Most plants were from 4 to 12 years old, and the oldest was 14 years old (p. 34). Individuals began flowering when they reached a stem diameter of 35 to 45 mm (1.4 to 1.8 in), corresponding to an age of 7 years (p. 18). In years of average and below-average rainfall, 60 percent and 5 percent of flowers bore fruit, respectively. Fruits produced an average of 162 seeds (from 37 to 370). Individuals produce an average of 385 seed in their lifetimes, far fewer than other cactus species that have been studied (p. 36). Seeds stored for 2 and 4 years at  $-20^{\circ}\text{C}$  ( $-4^{\circ}\text{F}$ ) had 89 and 40 percent germination, respectively, and germination was higher at  $30^{\circ}\text{C}$  ( $86^{\circ}\text{F}$ ) than at  $22^{\circ}\text{C}$  ( $72^{\circ}\text{F}$ ) (pp. 20-21). Annual mortality was 4 and 7 percent in average and dry years, respectively (p. 19). Causes of mortality included insect parasitism, trampling, and possible illicit collection. There were no indications of herbivory at populations on rangeland in Terrell County where goats, javelina (*Pecari tajacu*), and aoudad (*Ammotragus lervia*) were abundant (p. 19). These authors concluded that recruitment was likely to be episodic (p. 35) and that "...it is likely that *S. mariposensis* and *C. ramillosa* populations persist if large numbers of small patches are able to persist over time," (p. 36).

## Estimate of Minimum Viable Population size.

Minimum viable population (MVP) refers to the smallest population size that has a high probability of surviving a prescribed period of time. For example, Mace and Lande (1991, p. 151) propose that species or populations be classified as vulnerable when the probability of persisting 100 years is less than 90 percent. Determinations of MVP usually take into account the effective population size ( $n_e$ ), rather than total number of individuals ( $n$ ); 10 genetically identical individuals (for example, clones) would have an effective population size of 1.

A minimum viable population size (MVP) or Population Viability Analysis has not been calculated for bunched cory cactus, nor do we possess all the baseline demographic and life history data needed to perform these calculations. Table 4 is an adaptation of a method for estimating plant MVPs published in Pavlik (1996). Species with traits that all fall under column A would have MVPs of about 50 individuals. Those with traits that all ascribe to column C would have MVPs around 2,500 individuals. We added an intermediate column (B) to Pavlik's table to account for species with intermediate or unknown traits. The bold letters in the table indicate values, if known, for bunched cory cactus. Two factors require fewer individuals (perennial lifespan and climax successional status), four are intermediate (growth form, fecundity, ramet production, and survivorship), and three require more individuals (outcrossing, short duration of seed viability, and high environmental variation), suggesting an estimated MVP for bunched cory cactus in the intermediate range (roughly 1,000 to 1,500 individuals). Although outcrossing has not been documented for this species, most *Coryphantha* species require outcrossing (Zimmerman 1985, p. 137). The frequency and amount of fruit and seed

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production and the annual mortality rates documented by Schmalzel et al. (1999) are in the intermediate range of fecundity and mortality for cactus species and plants in general. Although most individuals of bunched cory cactus have a single stem, the ability to produce up to 15 secondary stems (or up to 25 in Coahuilan populations) falls in the intermediate range of ramet production. Seed viability declined rapidly even under ideal storage conditions (Schmalzel et al. 1999, pp. 20-21). Environmental variation ranks high due to wide annual fluctuations in precipitation in the species' Chihuahuan Desert habitats. This provisional MVP range may be revised in the future if accumulated data permits actual calculations. This estimate of MVP is based only on numbers of mature individuals (those that have flowered at least once or are judged capable of flowering) because most juvenile cactuses die before they are able to reproduce and therefore do not contribute to the gene pool or the effective population size. Furthermore, population surveys that do not distinguish mature plants from seedlings would appear to fluctuate wildly, depending on how recently seeds had germinated and the proportion of surviving seedlings.

Table 4. Minimum viable population guidelines applied to bunched cory cactus (adapted from Pavlik 1996, p. 137).

Factor	A. MVP of 50 individuals for species with these traits.	B. Intermediate MVP Range (1,000) for species with intermediate or unknown traits.	C. MVP of 2,500 individuals for species with these traits.
Longevity	<b>Perennial</b>		Annual
Breeding System	<u>Self-fertilization</u>		<b>Probably Outcrossing</b>
Growth Form	Woody	<b>Intermediate</b>	Herbaceous
Fecundity	High	<b>Intermediate</b>	Low
Ramet Production	Common	<b>Intermediate</b>	Rare or None
Survivorship	High	<b>Intermediate</b>	Low
Longevity of Seed Viability	Long		<b>Short</b>
Environmental Variation	Low		<b>High</b>
Successional Status	<b>Climax</b>		<u>Seral or Ruderal</u>

Hence, the current recovery criterion of 500 individuals (in each of 3 protected sites) may be too low. Like many cactus species, bunched cory cactus is distributed through its habitat in relatively small, scattered colonies. This patchy distribution pattern may be driven by natural factors, since larger populations may be more vulnerable to decimation by parasites or herbivores (USFWS 2017b, pp. 27-28, 31, 39-40)—as well as cactus poachers. It may be more practical to apply MVP sizes to metapopulations consisting of multiple colonies or subpopulations.

We are not aware of a scientific method to determine the minimum number of populations or metapopulations needed to assure long-term survival of a species; in general, more populations distributed over a wider geographic range are better. Although greater population redundancy reduces extinction risk, the degree of separation between populations is also important; there are

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both advantages and disadvantages to population independence (White 1996). Since the easternmost populations in Coahuila are now accepted as a distinct subspecies, the geographic range of bunched cactus is narrower than previously understood. Subspecies *ramillosa* is endemic to a moderate range in the Chihuahuan Desert. Therefore, its populations cannot be completely independent. For example, variation in climate, such as extended drought or catastrophic rainfall, would likely affect all populations similarly.

#### 2.3.1.4 Conservation Measures:

Desert Botanical Garden (DBG), located in Phoenix, Arizona, is a founding member of the Center for Plant Conservation (Desert Botanical Garden 2018a, p. 3) and serves as a sponsor and seed bank for bunched cory cactus (Center for Plant Conservation 2018). DBG's Living Plant Collections database (Desert Botanical Garden 2018b) indicates that they have 40 accessions of bunched cory cactus seeds collected between 1988 and 2013, 37 of which are dormant (viable) and 3 are no longer viable. These seeds in long-term storage could be used to restore populations lost to catastrophic events. Records of 95 individual bunched cory cactus plants in propagation areas and gardens show that 15 are currently living. Most of the older plants, sourced between 1986 and 1998, have died; however, 13 of the living plants are from 20 to 28 years old. In comparison, the average and maximum age of wild individuals at BIBE were 7.17 and 14 years (Schmalzel et al. 1999, pp. 17, 34, discussed in Section 2.3.1.3).

One population or metapopulation of bunched cory cactus occurs within BIBE. The National Park Service manages all species on their lands in accordance with the National Park Service Organic Act of 1916. BIBE protects populations of bunched cory cactus and its law enforcement officers discourage illegal collection. Since the park is federally owned land, it is also a violation of the Endangered Species Act (ESA) to remove and reduce to possession its threatened and endangered plant species. Federally funded or regulated actions that may affect Lloyd's mariposa cactus, including the National Park Services' operations and management of the park, are subject to consultation with USFWS under section 7 of the ESA.

Texas law protects state-listed plants (including bunched cory cactus) on public lands, including BIBE.

Section 7 consultations.

BIBE consulted with USFWS under section 7 of the ESA in the development of its Exotic Plant Management Plan (BIBE 2012). We concurred that the actions described in the plan are not likely to jeopardize the continued existence of bunched cory cactus (USFWS 2015). To the contrary, these actions will benefit this and other listed cactus species by reducing competition from buffelgrass (*Pennisetum ciliare*) and King Ranch bluestem (*Bothriochloa ischaemum*) and by preventing the trampling of cactus by feral livestock.

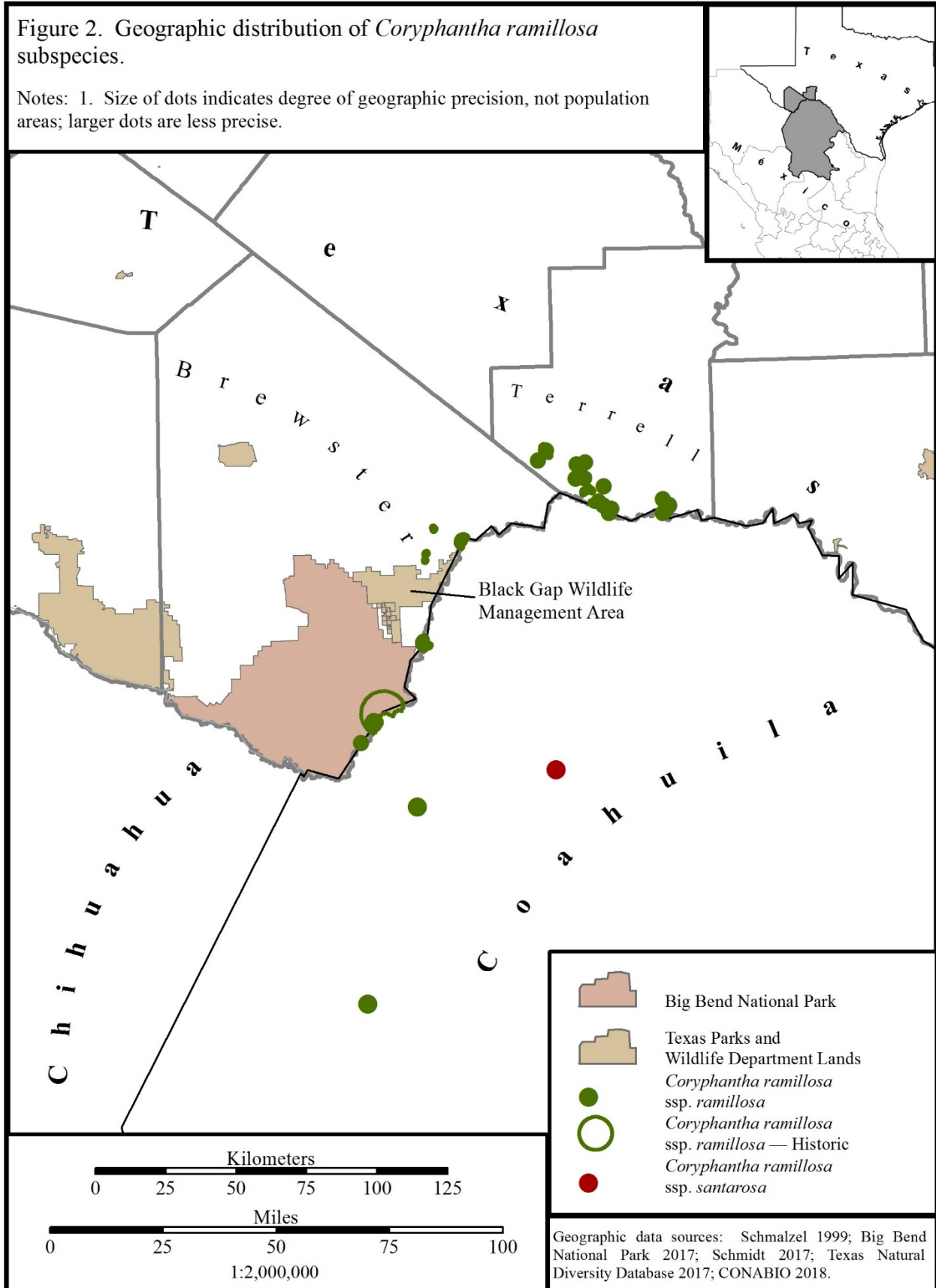
Section 6-funded grants.

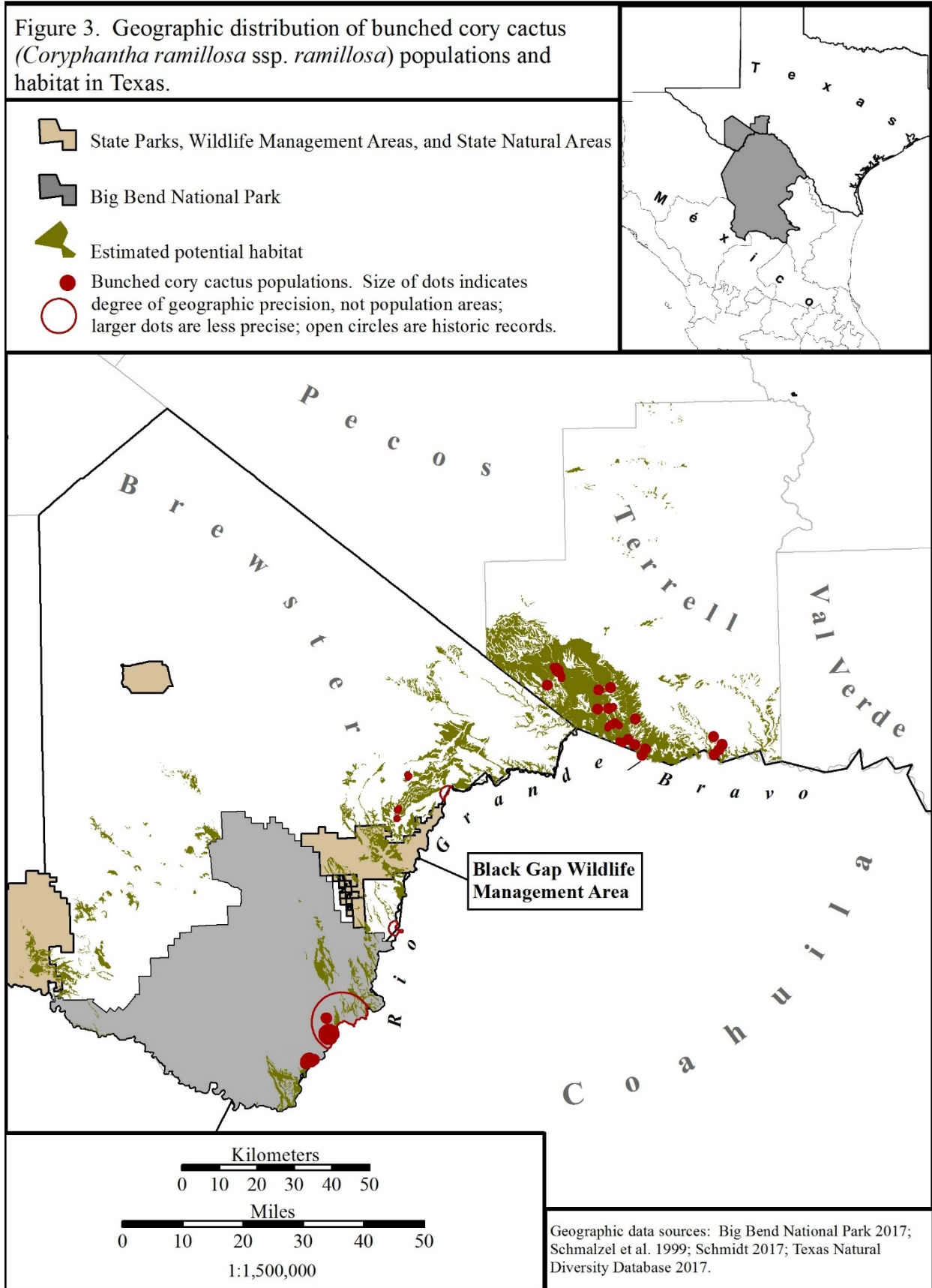
“The Cooperative Endangered Species Conservation Fund (section 6 of the ESA) provides grants to States and Territories to participate in a wide array of voluntary conservation projects for candidate, proposed, and listed species. The program provides funding to States and Territories for species and habitat conservation actions on non-Federal lands” (USFWS 2009).

In 2016 and 2017, TPWD and USFWS announced a priority request for proposals for section 6 funding to conduct habitat modeling and population estimates of bunched cory cactus and 3 other federally listed plants at BIBE. We have received proposals that address this priority for Fiscal Year 2018; however, grant selections for FY 2018 have not yet been announced.

Figure 2. Geographic distribution of *Coryphantha ramillosa* subspecies.

Notes: 1. Size of dots indicates degree of geographic precision, not population areas; larger dots are less precise.





### **2.3.2 Five-Factor Analysis (threats, conservation measures, and regulatory mechanisms).**

Table 5 (below) summarizes and compares threats to bunched cory cactus described in the federal listing and recovery plan, and our current understanding of threats.

Summary of prior information (44 FR 64247-64250; Weniger 1979, pp. 5-6; Heil et al. 1985, p. 31; USFWS 1989, pp. 8-9).

The primary threat is collection for the cactus trade that could increase due to increased access for recreation in the lower canyons of the Rio Grande scenic river area. Livestock grazing has little effect on most populations on private ranches due to the steep terrain; however, intensive range management practices could increase this threat, and land around Reagan Canyon has been heavily grazed. Off-road vehicles can damage habitats, but this threat is unlikely due to the rugged terrain of the habitats. Low total population numbers intensify the threats from other sources, and only one population, at BIBE, is legally protected.

#### **2.3.2.1 Present or threatened destruction, modification or curtailment of its habitat or range:**

Intensive range management practices, such as root-plowing and seeding with buffelgrass or other introduced, invasive grasses remains a potential threat, but has not been reported and is unlikely to occur due to the steep terrain and marginal capacity of the habitats for forage production. Some bunched cory cactus individuals may have been trampled at BIBE, due to their proximity to an archeological site (Schmalzel *et al.* 1999, p. 19). We have no evidence that trampling or habitat destruction has occurred due to increased recreational activity along the Rio Grande scenic river.

#### **2.3.2.2 Overutilization for commercial, recreational, scientific, or educational purposes:**

From a total of about 75 individuals along transects at BIBE, two disappeared; due to their proximity to visitor access they may have been stolen by poachers (Schmalzel *et al.* 1999, p. 19). We have no additional evidence of the current extent of illegal collection of this species. Since cactus collection continues to be a popular activity, and rare species collected from the wild are especially valuable to some collectors, bunched cory cactus will probably remain vulnerable to a persistent, low-grade threat of illegal collection.

#### **2.3.2.3 Disease or predation:**

Schmalzel *et al.* (1999, pp. 19-20) did not observe signs of mammalian herbivory in populations of bunched cory cactus where goats, javelina, and aoudad were abundant. However, they did observe insect frass on stems, indicating the presence of insect parasites (p. 19). Insect parasites cause populations collapses of other small cactuses, such as Tobusch fishhook cactus (USFWS 2017, pp. 27-28, 31, 39-40), and may also cause significant mortality of bunched cory cactus.

#### **2.3.2.4 Inadequacy of existing regulatory mechanisms:**

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The ESA does provide some legal protection for federally-listed plants on land under federal jurisdiction, including the populations of bunched cory cactus at BIBE.

Beginning in 2007, USFWS and the U.S. Department of Homeland Security (DHS) interacted extensively regarding the proposed construction of a border wall along the Rio Grande in south and west Texas. A provision of the REAL ID Act of 2005 gives the Secretary of Homeland Security authority to waive other federal laws, including the ESA, in order to expedite construction of border barriers. Hence, the border wall project was exempt from consultation with USFWS under section 7 of the ESA. Nevertheless, DHS and USFWS have coordinated to establish best management practices for the federally listed plants and animals in the project impact area (U.S. Department of Homeland Security 2008). Additional border wall construction has been proposed by the current Administration. If implemented, the border wall and related infrastructure may affect populations and habitats of bunched cory cactus that occur along the Rio Grande. In particular, the only protected population of bunched cory cactus, at BIBE, is near the Rio Grande and could be adversely affected by new construction in that area.

Chapter 88 of the Texas Parks and Wildlife Code lists plant species as state-threatened or endangered once they are federally-listed with these statuses. Bunched cory cactus was listed as threatened by the State of Texas on April 29, 1983. The State prohibits taking and/or possession for commercial sale of all or any part of an endangered, threatened, or protected plant from public land. TPWD requires permits for the commercial use of listed plants collected from private land. Scientific permits are required for collection of endangered plants or plant parts from public lands for scientific or educational purposes. In addition to State endangered species regulations, other State laws may apply. State law prohibits the destruction or removal of any plant species from State lands, including BGWMA, without a TPWD permit.

*Coryphantha ramillosa* is listed as a threatened species (category A) subject to protection in Mexico (Secretaría de Medio Ambiente y Recursos Naturales 2010, p. 55).

The Convention on International Trade in Endangered Species of Wild Flora and Fauna (2018) lists *Coryphantha ramillosa* in Appendix II.

### **2.3.2.5. Other natural or manmade factors affecting its continued existence:**

Demographic and genetic consequences of small population sizes.

Small, isolated plant populations are often vulnerable to genetic drift, loss of genetic diversity, and inbreeding depression. However, the population genetics of bunched cory cactus has not been investigated; we have no evidence of the extent of the actual impacts of these potential threats.

Climate change.

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The Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) (IPCC 2013) projects the following changes by the end of the 21<sup>st</sup> century, relative to the 1986 to 2005 averages: It is virtually certain that most land areas will experience warmer and/or fewer cold days and nights; it is virtually certain that most land areas will experience warmer and/or more frequent hot days and nights; it is very likely that the frequency and/or duration of warm spells and heat waves will increase in most land areas; it is very likely that the frequency, intensity, and/or amount of heavy precipitation will increase in mid-latitude land masses; it is likely that the intensity and/or duration of droughts will increase on a regional to global scale. The magnitude of projected changes varies widely, depending on the assumptions of future greenhouse gas emissions used by different models. For example, the RCP 2.6 model projects an increase of global mean surface temperatures of 0.3° to 1.7° C (0.5° to 3.1° F) by the end of the 21<sup>st</sup> Century. Under the RCP 8.5 model the increase would range from 2.6° to 4.8° C (4.7° to 8.6° F). The report also states, “In many mid-latitude and subtropical dry regions, mean precipitation will likely decrease...” However, these models do not simulate well the projected patterns of regional precipitation (IPCC 2013, p. 11).

We do not know whether the climate changes that have already occurred have affected the populations or distribution of bunched cory cactus, nor can we predict how the species might be affected by the type and degree of climate changes forecast by the range of models. While many species have adapted to previous climate changes by migrating in latitude or elevation, it is unlikely that this species could migrate, without facilitation, fast enough to match the projected rate of climate change. Changes in temperature and rainfall amounts and patterns could have multiple effects that alter the species’ fitness in opposing ways. For example, hotter summers could increase mortality from drought, but warmer winters could reduce mortality from freezing. Regardless of how these changes may affect its autecology, the altered synecology may be more significant. For example, bunched cory cactus might benefit from more frequent or more severe droughts if it tolerates extended drought better than other plants that compete with it. Conversely, extended drought could reduce pollinator populations, resulting in pollen limitation and reduced reproductive output. At present, we cannot predict how the infinitely complex aggregation of climate changes will affect the synecology of bunched cory cactus populations and habitat. Therefore, we will continue to monitor the species’ status and will adapt our recovery and management strategies when necessary to address the changing conditions.

We conclude that bunched cory cactus populations are currently threatened by illicit collection, although the degree of threat has remained low since the species was listed. Populations are widely scattered over rugged terrain that is difficult to access, and where the pace of development has remained slow. Parasitic infestations do occur in bunched cory cactus populations, although their extent is currently unknown. A portion of the species’ habitats and populations along the Rio Grande may be impacted by the construction of new border walls and related infrastructure. The demographic and genetic consequences of small population sizes are potential threats, but we have no evidence that these are currently affecting the species. The species may also be threatened by climate changes, but we are currently unable to predict how the species will react to projected changes.

Table 5. Factors affecting the survival of bunched cory cactus.

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44 FR 64247 and Recovery Plan	This review
A. The present or threatened destruction, modification, or curtailment of its habitat or range.	
<ul style="list-style-type: none"> <li>• The development of recreational access to the Rio Grande scenic river could increase impacts to habitats.</li> <li>• Off-road vehicles can damage habitats, but this is unlikely due to the rugged terrain.</li> </ul>	<ul style="list-style-type: none"> <li>• Traditional livestock grazing has had little effect on the species.</li> <li>• The potential threat from intensified grazing and range management practices is unlikely.</li> </ul>
B. Overutilization for commercial, recreational, scientific, or educational purposes.	
<ul style="list-style-type: none"> <li>• Not commonly found in the cactus trade, due to remoteness of populations.</li> <li>• The development of recreational access to the Rio Grande scenic river could increase access to the species' habitats and its vulnerability to illegal collection.</li> </ul>	<ul style="list-style-type: none"> <li>• Illicit collect continues to be a low-level threat.</li> <li>• Many populations are secure, due to remote, rugged terrain and lack of access.</li> </ul>
C. Disease or predation.	
<ul style="list-style-type: none"> <li>• Livestock grazing has little affect, but could increase if landowners adopt improved rangeland management practices and intensive grazing.</li> </ul>	<ul style="list-style-type: none"> <li>• Insect parasites have been observed, but their extent and effect on the species is unknown.</li> </ul>
D. The inadequacy of existing regulatory mechanisms.	
<ul style="list-style-type: none"> <li>• National Park Service regulations prohibit taking of natural resources—including bunched cory cactus—from a park; however, only one site is protected.</li> <li>• Listed in Appendix II of CITES, but this applies only to international trade.</li> </ul>	<ul style="list-style-type: none"> <li>• Endangered Species Act provisions can be waived by DHS for construction of border barriers.</li> <li>• Population at BIBE continues to be the only protected site.</li> </ul>
E. Other natural or man-made factors affecting its continued existence.	
<ul style="list-style-type: none"> <li>• Low total population numbers intensify threats from other sources.</li> </ul>	<ul style="list-style-type: none"> <li>• Demographic and genetic factors potentially threaten small isolated populations, but the current or future extent is unknown.</li> <li>• Climate changes may have multiple effects on fitness and survival; however, we are currently unable to project the net change to the species' viability.</li> </ul>

## 2.4 Synthesis.

*Coryphantha ramillosa* has consistently been recognized as a distinct, valid species. However, since the easternmost populations in Coahuila, Mexico, are now recognized as a distinct subspecies, *santarosa*, the listed entity, bunched cory cactus, is recognized as subspecies *ramillosa*. As a subspecies, bunched cory cactus is now somewhat more narrowly endemic to a portion of northern Coahuila and portions of two counties in the Big Bend region of Texas. The known populations occur on formations of highly fractured limestone of the Buda, Boquillas, and Santa Elena formations at elevations ranging from 400 to 1,100 m (1,312 to 3,609 ft). We provisionally estimate that about 151,022 ha (379,175 ac) of potential habitat occur in Brewster and Terrell counties. We have no information on the amount of habitat, the size and number of populations, or the precise geographic extent of the two subspecies in Coahuila.

Demographic studies on two transects observed the following: Estimates of first reproductive age range from 7 to 9 years, but individuals rarely live more than 12 or 14 years in the wild. Mature plants produced fairly typical numbers of seeds (for a small cactus), but since their reproductive life is short, individuals produced only about 385 seeds in their lifespans.

Several experts report that the subspecies is more abundant than was previously known, based on mostly qualitative observations, and have suggested that the species could be delisted. The estimated population size (based on a single, un-replicated sample) in 8 canyons on private ranches in Terrell County was 10,260 individuals. However, only one population, which had 256 individuals in 2004, is protected, at BIBE.

We have no evidence that large-scale commercial collection of this species from the wild has occurred, but the potential threat of illegal collection will probably continue indefinitely. Additional potential threats of unknown extent include insect parasitism, the genetic and demographic consequences of small population sizes, and climate changes.

Finally, the recovery criterion of 500 individuals per protected site is lower than our estimated MVP of 1,000 to 1,500 individuals; this should apply only to mature individuals of reproductive age. Due to the patchy distribution typical of rare cactus species, the MVP level may best be applied to metapopulations. The recovery plan should be revised to incorporate updated guidance and specific, measurable recovery criteria, including the length of the monitoring period needed to detect demographic trends.

We do not recommend changing the ESA classification of bunched cory cactus at this time, because: 1) The recovery criterion of three protected, managed populations with 500 or more individuals has not been met; only one site is protected, and has far fewer than 500 individuals; 2) we do not have quantitative, verifiable measures of the actual population sizes and trends; and 3) we have only incomplete information on population sizes, geographic distribution, land ownership, or land use and management of the Coahuilan populations. However, it may be possible to justify delisting bunched cory cactus in the near future through the use of valid scientific methods to determine population sizes and trends, some form of landowner agreement to protect populations on private land, and coordination with Mexican agencies and conservation organizations to promote the species' conservation in Mexico.

### 3.0 RESULTS

#### 3.1 Recommended Classification:

**Downlist to Threatened**

**Uplist to Endangered**

**Delist** (*Indicate reasons for delisting per 50 CFR 424.11*):

*Extinction*

*Recovery*

*Original data for classification in error*

**No change is needed**

#### 3.2 New Recovery Priority Numbers:

15C.

#### Brief Rationale:

The Recovery Priority Number for bunched cory cactus prior to this review was 8. This indicates that the threat level was moderate, the recovery potential was high, the taxon was a species, and no conflicts with construction, development projects, or other forms of economic activity were foreseen. Our current assessment is that the degree of threat is low: the species is moderately endemic and uncommon within its range, but most habitats are very difficult to access, relatively little development is taking place, and we are not aware of large-scale commercial collection for the cactus trade. The impacts of some threats, such as insect parasitism, small population sizes, and climate changes, are unknown. The recovery potential is high: although the species is endemic to a moderately restricted range, it is more abundant than previously known, and one population is protected at BIBE. The entity listed for protection under the ESA is now a subspecies because a portion of the original species has been recognized as a separate subspecies. The proposed construction of new border walls through a portion of the range represents a clear conflict with construction. Therefore, the current Recovery Priority Number is 15C (low threat, high recovery potential, subspecies, conflict).

#### 4.0 RECOMMENDATIONS FOR FUTURE ACTIONS.

To ascertain the degree to which the recovery criteria of bunched cory cactus have been met, we recommend the following:

- Develop efficient, quantitative, verifiable methods to estimate population sizes and trends using representative samples of potential habitats and valid statistical analyses.
- Recruit Mexican botanists and support studies of the size and geographic distribution of populations in Coahuila and Nuevo León.

The most important recovery actions during the next five years include, but are not limited to, the following:

- Revise the recovery plan and recovery criteria to incorporate updated guidance and specific, measurable recovery criteria, including the length of the monitoring period needed to detect demographic trends. Revise the population size criterion to the provisional minimum viable population level of 1,000 to 1,500 mature, reproductive individuals per metapopulation.
- Continue to improve the potential habitat model as we learn more about the ecological requirements.
- Explore the potential to conserve populations of bunched cory cactus on private lands in Brewster and Terrell counties, Texas through private landowner agreements or other appropriate measures.
- Communicate with Mexican agencies, non-profit conservation organizations, and academic institutions to promote the conservation and management of *Coryphantha ramillosa* subspecies in Mexico.
- Investigate the population genetics to determine the genetic structure, genetic diversity and extent of inbreeding, evidence of gene flow, and other parameters that will be useful in the conservation and recovery of bunched cory cactus.

## 5.0 Literature Cited.

- Anderson, E.F. 2001. *The Cactus Family*. Timber Press, Portland, Oregon. 776 pp.
- Benson, L. 1982. *The Cacti of the United States and Canada*. Stanford University Press, Stanford, California. 1,044 pp.
- Big Bend National Park. 2012. Draft Exotic Plant Management Plan and Environmental Assessment. September 2012. 94 pp. + 6 Appendices.
- Center for Plant Conservation. 2017. Plant Profile: *Coryphantha ramillosa*. <https://saveplants.org/national-collection/plant-search/>. Accessed June 10, 2018.
- CONABIO (Comisión Nacional para el Conocimiento y Uso de la Biodiversidad). 2018. Search of Mexican Herbaria through REMIB (Red Mundial de Información sobre Biodiversidad) for *Coryphantha ramillosa* and its infrataxa. [http://www.conabio.gob.mx/remib/doctos/remib\\_esp.html](http://www.conabio.gob.mx/remib/doctos/remib_esp.html). Accessed April 12, 2018.
- Convention on International Trade in Endangered Species of Wild Fauna and Flora. 2018. Appendices I, II, and III valid from 4 October 2017. <https://www.cites.org/eng/app/appendices.php>. Accessed: June 10, 2018.
- Cutak, L. 1942. *Coryphantha ramillosa*: A new species from the Big Bend Region of Texas. *Cactus and Succulent Journal (U.S.)* 14: 163-164.
- Desert Botanical Garden. 2018a. Species and habitat conservation. <http://www.dbg.org/species-habitat-conservation>. Accessed June 10, 2018.
- Desert Botanical Garden. 2018b. Living plant collections database. <https://www.dbg.org/living-plant-collections>. Accessed June 10, 2018.
- Dicht, R.F. and A.D. Lüthy. 2000. *Coryphantha ramillosa* subsp. *santarosa* Dicht & A. Lüthy subsp. nov. *Kakteen und andere Sukkulenten*. 51(6): 141.
- Dicht, R.F. and A.D. Lüthy. 2005. *Coryphantha: Cacti of Mexico and Southern USA*. Translated from German by Eugen Ulmer GmbH & Co., Stuttgart, Germany. Springer-Verlag. 200 pp.
- Earlham College Southwest Field Studies. 1986. Survey of *Mammillaria ramillosa*. March 11-12, 1986.
- Frisch, A. and B.B. Amos. 2015. Preliminary review: Current range of the threatened bunched cory cactus in defining potential habitat. CITR Poster.
- Heil, K.D., S. Brack, and J.M. Potter. 1985. The rare and sensitive cacti of Big Bend National Park. September 1985. Pp. 29-32.

## Bunched Cory Cactus Five-Year Review - Final

- Integrated Taxonomic Information Service. 2018. *Coryphantha ramillosa* ssp. *ramillosa* Cutak. <http://www.itis.gov>. Accessed April 12, 2018.
- Intergovernmental Panel on Climate Change. 2013. Summary for Policymakers. In T.F. Stocker, D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.), *Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. 29 pp.
- Mace, G.M. and R. Lande. 1991. Assessing extinction threats: Toward re-evaluation of IUCN threatened species categories. *Conservation Biology* 5: 148-157.
- Natural Resources Conservation Service. 2017. United States Department of Agriculture. Web Soil Survey. <http://websoilsurvey.nrcs.usda.gov/> Accessed: March 30, 2017.
- Natural Resources Conservation Service. 2018. The PLANTS Database. Plants Profile for *Coryphantha ramillosa* (Whiskerbush). <http://plants.usda.gov/>. Accessed: April 12, 2018. National Plant Data Center, Baton Rouge, LA 70874-4490 USA.
- Pavlik, B.M. 1996. Defining and Measuring Success. Pp. 127-155 in D.A. Falk, C.I. Millar, and M. Olwell (eds.), *Restoring Diversity: Strategies for reintroduction of endangered plants*. Island Press, Washington, D.C. 505 pp.
- Poole, J., W. Carr, D. Price, and J. Singhurst. 2007. *The Rare Plants of Texas*. Texas A&M University Press. College Station, Texas. 640 pp.
- Powell, A.M., J.F. Weedon, and S.A. Powell. 2008. *Cacti of Texas: A field guide*. Texas Tech University Press, Lubbock Texas. 383 pp.
- Schmalzel, R., E.F. Anderson, K. Rice, and P. Quirk. 1999. Study of the bunched cory cactus (*Coryphantha ramillosa* Cutak). Final Report. FWS Agreement No.: 1448-00002-96-0854. Desert Botanical Garden, Phoenix, Arizona. 63 pp.
- Schmidt, O.G. 2017. A report on four rare plant species of Big Bend National Park, Texas Master of Arts Report. University of Texas at Austin. 107 pp.
- Secretaría de Medio Ambiente y Recursos Naturales. 2010. NORMA Oficial Mexicana NOM-059-SEMARNAT-2010: Protección ambiental—Especies nativas de México de flora y fauna silvestres—Categorías de riesgo y especificaciones para su inclusión, exclusión o cambio—Lista de especies en riesgo. Diario Oficial (Mexican Federal Government). December 30, 2010.

Bunched Cory Cactus Five-Year Review - Final

- Stoeser, D.B., G.N. Green, L.C. Morath, W.D. Heran, A.B. Wilson, D.W. Moore, and B.S. Van Gosen. 2005. Txgeol\_dd\_polygon.shp. U.S. Geological Survey, Denver, CO. <http://pubs.usgs.gov/of/2005/1351/>. Accessed: May 27, 2010.
- Texas Natural Diversity Database. 2017. Element occurrence printouts for *Coryphantha ramillosa*. Wildlife Diversity Program of Texas Parks and Wildlife Department. February 14, 2017.
- Tropicos. 2018. Missouri Botanical Garden. *Coryphantha ramillosa* Cutak subsp. *ramillosa*. <http://www.tropicos.org/Name/50335675>. Accessed April 12, 2018.
- U.S. Department of Homeland Security, U.S. Customs and Border Protection, and U.S. Border Patrol Rio Grande Valley Sector. 2008. Biological Resources Plan for Construction, Operation, and Maintenance of Tactical Infrastructure for Rio Grande Valley Sector, Texas. Prepared in July 2008.
- U.S. Fish and Wildlife Service. 1989. Bunched Cory Cactus (*Coryphantha ramillosa*) Recovery Plan. U.S. Fish and Wildlife Service, Albuquerque, New Mexico. 49 pp.
- U.S. Fish and Wildlife Service. 2009. Cooperative Endangered Species Conservation Fund (Section 6 of the ESA). [http://www.fws.gov/endangered/factsheets/Sec6\\_Factsheet\\_2009.pdf](http://www.fws.gov/endangered/factsheets/Sec6_Factsheet_2009.pdf). Accessed June 20, 2009.
- U.S. Fish and Wildlife Service 2015. Biological Opinion on Consultation No. 02ETAU00-2015-F-0333 on Big Bend National Park Exotic Species Management Plan. December 15, 2015.
- U.S. Fish and Wildlife Service. 2017a. Recovery Planning and Implementation User Guide, Version 2.0. U.S. Fish and Wildlife Service, Arlington, VA. 32 pp. + 2 appendices.
- U.S. Fish and Wildlife Service. 2017b. Species status assessment of Tobusch Fishhook Cactus (*Sclerocactus brevihamatus* ssp. *tobuschii* (W.T. Marshall) N.P. Taylor). U.S. Fish and Wildlife Service Southwest Region, Albuquerque, New Mexico. 64 pp. + 2 appendices.
- Weedin, J.F., A.M. Powell, and D.O. Kolle. 1989. Chromosome numbers in Chihuahua Desert Cactaceae. II. Trans-Pecos Texas. *The Southwestern Naturalist* 34: 160-164.
- Weniger, D. 1970. *Cacti of the Southwest*. University of Texas Press, Austin, Texas.
- Weniger, D. 1979. Status report on *Coryphantha ramillosa*. Prepared for U.S. Fish and Wildlife Service, Albuquerque, New Mexico. 11 pp.

## Bunched Cory Cactus Five-Year Review - Final

White, P.S. 1996. Spatial and Biological Scales in Reintroduction. Pp. 49-86 in D.A. Falk, C.I. Millar, and M. Olwell (eds.), *Restoring Diversity: Strategies for reintroduction of endangered plants*. Island Press, Washington, D.C. 505 pp.

Zimmerman, A.D. 1985. Systematics of the Genus *Coryphantha* (Cactaceae). Doctoral Dissertation. The University of Texas at Austin. 449 pp.

Zimmerman, A.D., and B. Parfitt. 2004a. *Coryphantha* (Engelmann) Lemaire. In: Flora of North America Editorial Committee, eds. 1993+. *Flora of North America North of Mexico*. 16+ vols. New York and Oxford. Vol. 4, p. 220.  
[http://www.efloras.org/florataxon.aspx?flora\\_id=1&taxon\\_id=108121](http://www.efloras.org/florataxon.aspx?flora_id=1&taxon_id=108121). Accessed April 12, 2018.

Zimmerman, A.D., and B. Parfitt. 2004b. *Coryphantha ramillosa* Cutak. In: Flora of North America Editorial Committee, eds. 1993+. *Flora of North America North of Mexico*. 16+ vols. New York and Oxford. Vol. 4, p. 225.  
[http://www.efloras.org/florataxon.aspx?flora\\_id=1&taxon\\_id=242415318](http://www.efloras.org/florataxon.aspx?flora_id=1&taxon_id=242415318). Accessed April 12, 2018.

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### **ABBREVIATIONS OF SCIENTIFIC UNITS**

<u>Abbreviation</u>	<u>Scientific Unit</u>
ac	acres
cm	centimeters
° C	degrees Celsius
° F	degrees Fahrenheit
ft	feet
ha	hectares
in	inches
km	kilometers
m	meters
mi	miles
mm	millimeters

**GLOSSARY OF TECHNICAL TERMS.**

Term	Definition
Alluvium	Loose, unconsolidated soil or sediments, eroded, deposited, and reshaped by water in some form in a non-marine setting (Wikipedia 2013).
Areole	Specialized axillary bud or short shoot in cactus species; the spine cushion, producing leaves, spines, and flowers (Anderson 2001)
Autecology	Ecology of individual species.
Breeding System	The ability of a plant species to reproduce via outcrossing, self-fertilization, apomixis, or a combination (Wikipedia 2015).
Central spines	One of the innermost spines of an areole (Anderson 2001).
Climax Succession	Late, relatively stable stage of ecological succession.
Clone	Asexually reproduced progeny that are genetically identical to parent organism.
Critical habitat	"...(i) the specific areas within the geographical area occupied by the [threatened or endangered] species, at the time it is listed in accordance with the provisions of section 4 of [the ESA], on which are found those physical or biological features (I) essential to the conservation of the species and (II) which may require special management considerations or protection; and (ii) specific areas outside the geographical area occupied by the species at the time it is listed in accordance with the provisions of section 4 of [the ESA], upon a determination by the Secretary that such areas are essential for the conservation of the species." U.S. Congress 1988.
Demography	Scientific study of populations.
Digital Elevation Model	Digital model or 3D representation of a terrain's surface — commonly for a planet (including Earth), moon, or asteroid — created from terrain elevation data (Wikipedia 2015).
Diploid	Organism or structure possessing two replicate sets of chromosomes.
Dorsal	The surface of a plant facing away from the stem or axis (Correll and Johnston 1979).
Effective population size	The size of an idealized population in which individuals contribute equally to the gamete pool and have the same variation in allele frequencies and levels of inbreeding as the observed population (Barrett and Kohn 1991).
Endangered	"...any species which is in danger of extinction throughout all or a significant portion of its range other than a species of the Class Insecta determined by the Secretary to constitute a pest whose protection under the provisions of this Act would present an overwhelming and overriding risk to man." U.S. Congress 1988.
Epithet	The species name in a binomial taxonomic classification.
Extrafloral nectary	Specialized nectar-producing gland located outside the flower (Anderson 2001).
Filament	The stalk of an anther (Correll and Johnston 1979, p. 1752).

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Term	Definition
Genetic drift	A change in allele frequencies within a population over time.
Genetic structure	Any pattern in the genetic makeup of individuals within a population (Wikipedia 2011).
Glabrous	Lacking surface ornamentation, such as trichomes; glabrate = nearly glabrous (Correll and Johnston 1979).
Habitat	Ecological or environmental area that is inhabited by a particular species of animal, plant or other type of organism (Wikipedia 2013).
Halictid	A cosmopolitan family of the order Hymenoptera consisting of small (> 4 mm) to midsize (> 8 mm) bees which are usually dark-colored and often metallic in appearance; commonly referred to as sweat bees (Wikipedia 2011).
Imbricate	Arrangement in two or more overlapping series.
Inbreeding depression	The reduction of fitness caused by mating between relatives (Edmands 2007, p. 464).
Lithic	Composed of sedimentary rock fragments.
Metapopulation	A group of spatially separated populations of the same species that interact at some level (Wikipedia 2013).
Minimum viable population	The fewest individuals required for a specified probability of survival over a specified period of time (Pavlik 1996; Mace and Lande 1991); see Population Viability Analysis.
Monograph	Comprehensive treatise on all the known taxa within a specific taxonomic group.
Outcross	In plants, sexual fertilization involving the union of gametes from different individuals.
Perianth	The floral envelopes collectively; usually used when calyx and corolla are not clearly differentiated. (Correll and Johnston 1979).
Phenology	Seasonal pattern of plant growth, development and reproduction.
Phylogeny	The study of evolutionary relatedness among various groups of organisms (e.g., species, populations), which is discovered through molecular sequencing data and morphological data matrices (Wikipedia 2013).
Pollen Limitation	Reduced reproductive output of a plant due either to insufficient pollen sources or a lack of pollinators.
Population	Collection of inter-breeding organisms of a particular species (Wikipedia 2013).
Population Viability Analysis	Statistical models used to predict the probability of extinction of a population after a specified period of time.
Porrect	Directed outward and forward; vertical to the substatum (Correll and Johnston 1979).
Radial spines	One of the outermost spines of an areole, often radiating or appressed (Anderson 2001).

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Term	Definition
Ramet	An individual, genetically-identical plant reproduced as a clone of the parent plant.
Recruitment	Addition of new individuals to a population.
Redundancy	The number of populations or sites necessary to endure catastrophic losses (Shaffer and Stein 2000, pp. 308-310).
Reticulate	Netlike surface ornamentation or veination.
Ruderal	Early stage of succession (colonization).
Scrubland	Alternate term for <u>shrubland</u> .
Section	In botany, a section is a taxonomic rank below the genus and subgenus, but above series and species (Wikipedia 2013).
Section 6	Cooperative Endangered Species Conservation Fund (Section 6 of the ESA). (USFWS 2009)
Section 7	The section of the Endangered Species Act of 1973, as amended, outlining procedures for interagency cooperation to conserve Federally listed species and designated critical habitats (USFWS and NMFS 1998, p. xviii).
Self-fertilization	Sexual reproduction involving the union of gametes from a single individual.
Seral	An intermediate developmental stage in ecological succession (Wikipedia 2013).
Series	In botany and plant taxonomy...a subdivision of a genus, a taxonomic rank below that of section (and subsection) but above that of species (Wikipedia 2015).
Shrubland	Vegetation composed of shrubs (many-stemmed woody plants, generally less than 6 m tall) (NatureServe 2010).
Soil map unit	One or more soils or miscellaneous areas described in a soil survey that can be geographically represented as polygons on a map.
Species	One of the basic units of taxonomic identity (Wikipedia 2013). Multiple species definitions exist, including the biological, phylogenetic, evolutionary, etc. The biological definition (“... groups of actually or potentially interbreeding natural populations, which are reproductively isolated from other such groups” (Mayr 1942)) is adopted in the ESA but does not apply well to all organisms. Singular and plural abbreviations are sp. and spp., respectively.
Stigma	The receptive part of the pistil on which the pollen germinates. (Correll and Johnston 1979).
Style	A narrowed, often elongate portion of a pistil between the stigma and ovary (Correll and Johnston 1979).
Subgenus	A subdivision of a genus, comprising one or more species which differ from other species of the genus in some important character or characters (Biology-online.org 2011).

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Term	Definition
Subspecies	A taxonomic group that is a division of a species; usually arises as a consequence of geographical isolation within a species (Biology-online.org 2011). Abbreviated ssp.
Subtropical	Climatic region intermediate between tropical and temperate, where freezing temperatures occur infrequently and are of limited duration and intensity.
Sulca	A furrow or groove (Correll and Johnston 1979).
Synecology	Ecology of groups of coexisting organisms.
Systematics	The study of the diversification of life on the planet Earth, both past and present, and the relationships among living things through time, visualized as evolutionary trees (Wikipedia 2011).
Taxon	(Plural, taxa). A natural group of organisms at any rank in the taxonomic hierarchy (Anderson 2001).
Taxonomy	Scientific classification of living organisms.
Testa	Seed coat.
Threatened	"...any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range." United States Congress 1988.
Tomentose	Covered with short, densely matted, soft white wool (Correll and Johnston 1979); velvety.
Torriorthents	A course, silty entisol (Wiktionary 2018).
Transect	An ecological sample unit of relatively narrow width and much greater length conducted in a specified direction.
Tubercle	A conical or cylindrical outgrowth or protuberance from a cactus stem, usually bearing all or part of the areole; podarium (Anderson 2001).
Ustic	A soil moisture regime in which limited moisture is present when conditions are suitable for plant growth (Soil Science Society of America 2018).
Variety	A taxonomic rank below subspecies in botany (Biology-online.org 2011). Abbreviated var.
Vegetative cover	The proportion of an area that is intercepted vertically by tissues of a specified taxon or type of plants; total cover may exceed 1 due to multiple layers.

Literature cited in glossary.

Anderson, E.F. 2001. *The Cactus Family*. Timber Press, Portland, OR. 776 pp.

Barrett, S.C.H. and J.R. Kohn. 1991. Genetic and evolutionary consequences of small population size in plants: Implications for conservation. Pp. 3-30 *in* Falk, D.A. and K.E. Holsinger (eds.), *Genetics and Conservation of Rare Plants*. Oxford University Press, New York, New York.

Biology-online.org. 2011. <http://www.biology-online.org/dictionary/> Accessed June 30, 2011.

Bunched Cory Cactus Five-Year Review - Final

- Correll, D.S. and M.C. Johnston. 1979. *Manual of the vascular plants of Texas*. University of Texas at Dallas, Richardson, Texas. 1881 pp.
- Edmands, S. 2007. Between a rock and a hard place: evaluating the relative risks of inbreeding and outbreeding for conservation and management. *Molecular Ecology* 16: 463-475.
- Mace, G.M. and R. Lande. 1991. Assessing extinction threats: Toward re-evaluation of IUCN Threatened Species Categories. *Conservation Biology* 5:148-157.
- Mayr, E. 1942. *Systematics and the Origin of Species*. Columbia University Press, New York.
- NatureServe. 2010. Glossary. [http://www.natureserve.org/explorer/glossary/gloss\\_a.htm](http://www.natureserve.org/explorer/glossary/gloss_a.htm). Accessed March 5, 2010.
- Pavlik, B.M. 1996. Defining and measuring success. Pp 127-155 *in* Falk, D.A., C.I. Millar, and M. Olwell, (eds.), *Restoring Diversity: Strategies for reintroduction of endangered plants*. Island Press, Washington, D.C. 505 pp.
- Shaffer, M.L. and B.A. Stein. 2000. Safeguarding our Precious Heritage. Pages 301-321 *in* B.A. Stein, L.S. Kutner, and J.S. Adams (eds.), *Precious Heritage: The status of biodiversity in the United States*. Oxford University Press. 399 pp.
- Soil Science Society of America. 2018. Glossary of Soil Science Terms. <https://www.soils.org/publications/soils-glossary#>. Accessed May 23, 2018.
- U.S. Congress. 1988. *Endangered Species Act of 1973, as amended through the 100th Congress*. U.S. Government Printing Office, Washington, D.C.
- U.S. Fish and Wildlife Service and National Marine Fisheries Service. 1998. *Endangered Species Consultation Handbook: Procedures for conducting section 7 consultations and conferences*. <https://www.fws.gov/endangered/esa-library/pdf/TOC-GLOS.PDF>. Accessed September 12, 2016.
- U.S. Fish and Wildlife Service. 2009. *Cooperative Endangered Species Conservation Fund (Section 6 of the ESA)*. [http://www.fws.gov/endangered/factsheets/Sec6\\_Factsheet\\_2009.pdf](http://www.fws.gov/endangered/factsheets/Sec6_Factsheet_2009.pdf). June 20, 2009.
- Wikipedia. Org. 2018. Articles on alluvium, digital elevation model, genetic structure, habitat, mating system (breeding system), metapopulation, phylogeny, population, section, seral, series, species, and systematics. Accessed July 6, 2018.
- Wiktionary.org. 2018. Definition of Torriorthent. <https://en.wiktionary.org/wiki/entisol>. Accessed May 23, 2018.

**U.S. FISH AND WILDLIFE SERVICE**  
**5-YEAR REVIEW of**  
*Coryphantha ramillosa ssp. ramillosa*

**Current Classification:** Threatened.

**Recommendation resulting from the 5-Year Review:**

- Downlist to Threatened
- Uplist to Endangered
- Delist
- No change needed.

**Review Conducted By:** Chris Best, State Botanist, Austin Ecological Services Field Office.

**FIELD OFFICE APPROVAL:**

**Lead Field Supervisor, U.S. Fish and Wildlife Service**

Approved \_\_\_\_\_

Date \_\_\_\_\_

July 6, 2018