Draft Recovery Plan Amendment for Black Lace Cactus

Recovery Plan for *Echinocereus reichenbachii* var. *albertii* Benson (Black Lace Cactus).
https://ecos.fws.gov/docs/recovery_plan/870318b.pdf

Draft Amendment 1

Superseding only Part II, page 24 of the recovery plan.

U.S. Fish and Wildlife Service
Region 2
Albuquerque, New Mexico
March 2019

I. Background Information.

I.a. Summary of prior actions.

Listing:	44 FR 61918.
Date:	October 26, 1979.
Listed entity:	Black lace cactus (*Echinocereus reichenbachii* var. *albertii*).
Listed status:	Endangered.
Recovery Plan:	U.S. Fish and Wildlife Service (USFWS) 1987.
Prepared by:	Dr. Sue Gardner and Ruth O'Brien.
Approved:	March 18, 1987.
Five-year review(s):	March 26, 2009 (USFWS 2009).

I.b. Reason for amendment.

Section 4(f)(1)(B)(ii) of the Endangered Species Act (ESA) requires that each recovery plan shall incorporate, to the maximum extent practicable, "objective, measurable criteria which, when met, would result in a determination…that the species be removed from the list." Legal challenges to recovery plans (see Fund for Animals v. Babbitt, 903 F. Supp. 96 (D.D.C. 1995)) and a Government Accountability Audit (GAO 2006) also have affirmed the need to frame recovery criteria in terms of threats assessed under the five factors (ESA 4(a)(1)).

Recovery criteria serve as objective, measurable guidelines to assist in determining when an endangered species has recovered to the point that it may be downlisted (reclassified) to threatened, or that the species is no longer at risk of extinction and may be delisted (removed from the Federal Lists of Endangered and Threatened Wildlife and Plants). The term "threatened species" means any species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range. The term "endangered species" means any species (species, sub-species, or distinct population segment) that is in danger of extinction throughout all or a significant portion of its range.

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The original black lace cactus recovery plan included a single downlisting criterion:

> Downlisting of *Echinocereus reichenbachii* var. *albertii* to threatened can be accomplished when permanent protection is obtained for the existing number of plants at two or more of the known populations (USFWS 1987, p. 24).

The recovery plan did not provide guidance on what constitutes permanent protection or specify the existing numbers of plants, and did not establish delisting criteria. The 5-year review (USFWS 2009, p. 27) recommended amending the recovery plan to include objective and measurable recovery criteria for both downlisting and delisting that address all relevant listing factors.

This amendment to the recovery plan establishes specific, measurable criteria for downlisting and delisting that address the recovery objectives and known threats, comply with updated recovery planning guidance, and incorporate new information on the species obtained during the 5-year review (USFWS 2009) and other recent sources.

I.c. Brief summary of the species' current status.

Taxonomic classification.

Benson (1982, p. 946) included the taxa *fitchii* and *albertii* as varieties of *Echinocereus reichenbachii*. Blum *et al*. (2004) revised the systematics of the *Echinocereus reichenbachii* and *E. fitchii* complex. Based primarily on spine morphology, they described *E. fitchii* as a distinct species (pp. 238–256, 300, 310–313) and classified *albertii* as a subspecies of *E. fitchii* (pp. 257–264, 300). Berresford (2011), Lange and Sinclair (2013), and Williamson *et al*. 2016 (as indicated by Terry (2017, p. 1)) have adopted the taxonomic treatment of Blum *et al*. (2004).

Berresford (2011) described characteristics of the subspecies of *E. fitchii* based on field observations. Subspecies *fitchii* had dense, mostly pale spines that overlap with spines from adjacent areoles, concealing most of the stem, and areoles also had multiple brown-tipped central spines (pp. 187–188, 194) (figure 1.4). In contrast, the stems of ssp. *albertii* were visible between areoles, and the tips of [radial] spines "tended to be black"; at the Refugio County population, most plants had no central spines, or at most one weak central spine, while most individuals at the Kleberg County population had one strong central spine (pp. 192–193). (figure 1.3). The populations topic below provides more information about these sites. Berresford concluded that the subspecies *fitchii* and *albertii* are taxonomically distinct (p. 194).

Lange and Sinclair (2013) observed that tuberous roots and the lack of central spines in mature individuals distinguish *E. reichenbachii*, while *E. fitchii* has fibrous roots and central spines (the Refugio County population of ssp. *albertii* has very small central spines on only some areoles) (p. 73). In addition, the dark flower throat (tepal bases) of all *E. fitchii* subspecies is adjacent to the lighter pink outer zone, while flowers of *E. reichenbachii* subspecies initially have a bright band between the dark pink-magenta inner and lighter pink-magenta outer zones (pp. 73–74) (figures 1.1, 1.2, and 1.5). These authors distinguished ssp. *albertii* by (0) 1–4 black or gray central spines, while ssp. *fitchii* has 4–7 central spines that are white with brown tips (p. 74).

In addition to these morphological observations, we note that *E. fitchii* ssp. *fitchii* occurs on gravelly sandstone-derived upland soils, often with high gypsum (calcium sulfate) levels, in Starr, Jim Hogg, Zapata, and Webb Counties and adjacent Mexico. In contrast, *E. fitchii* ssp. *albertii* (following the taxonomy of Blum *et al*. 2004) occurs in saline sandy-clay flood plains of watercourses draining into the Gulf of Mexico; known populations of these two subspecies are separated by at least 100 kilometers (km) (61 miles (mi)) (Figure 2).

Phylogenetic research.

Williamson *et al*. 2016 (p. 4–6) summarized interim progress of an ongoing phylogenetic study of the *reichenbachii-fitchii* complex. The investigated taxa include subspecies of *E. reichenbachii* (*caespitosus*, *perbellus*, *baileyi*), and *E. fitchii* (*fitchii* and *albertii*), with *E. pectinatus* ssp. *wenigeri* as an outgroup. This project uses RADseq genotyping on non-invasive tepal or spine tissue samples from up to 3 populations and 45 individuals per taxon. Peter Berresford, a British *Echinocereus* expert (cited in Berresford 2011), is collaborating on this project. By 2016, samples had been collected from the McMullen and Refugio County populations of ssp. *albertii*, 4 populations of ssp. *fitchii*, 4 populations of ssp. *caespitosus*, 2 populations of ssp. *perbellus*, 3 populations of ssp. *baileyi*, and 2 populations of *E. pectinatus* ssp. *wenigeri*. Terry (2017) reported additional collections of *albertii* genetic samples from McMullen County, a cluster of populations in southern Atascosa County, and Kleberg County. Terry (2019) reported that these investigators were collecting additional tissue samples during the spring of 2019 and expected to complete the phylogenetic analyses later that year.

Life history.

Ross (1981, p. 468) determined that *Echinocereus reichenbachii* var. *albertii* is self-infertile (requires outcrossing). Emmett (1989, pp. 7–8) observed bumblebees, wasps, beetles, and small bees visiting the flowers, but did not study pollinator effectiveness. Berresford (2011, pp. 192–193) included a photograph (by F. Weaver) of a *Diadasia* bee visiting a black lace cactus flower. Several species of *Diadasia* are cactus specialists (Sipes and Tepedino 2005, Table 2), and may also be important pollinators of black lace cactus. Bee forage ranges are correlated with body size (Greenleaf *et al*. 2007); although the pollinator(s) have not been determined, the effective pollination range is likely to be at least several hundred meters up to a few kilometers. Hence, populations that are more than a few kilometers distant are reproductively isolated.

Botanists from Texas Parks and Wildlife Department (TPWD) collected 2,143 seeds from 24 fruits (89 per fruit) at the Refugio County population in 2004, and 2,580 seeds from 12 fruits at this population in 2006 (215 per fruit) (USFWS 2009, pp. 7–8). Emmett (1989) estimated an average of 545 seeds per fruit at the Kleberg County population (p. 51). Since individual black lace cactuses can produce one to several fruits per year, the species has a moderate level of fecundity.

Emmett (1989) investigated the soil seed reserve of the Kleberg County black lace cactus population. The known populations occur in saline fine sandy loam within several hundred meters of watercourses, in the coastal grassland—Rio Grande plain scrub ecotone, and are

occasionally flooded (p. 3). Emmett observed black lace cactus flowering from March through June, with a peak in mid-April to May (p. 3). The spiny, drably colored fruits did not attract birds and mammals, remained attached to the stems, and when ripe, split open longitudinally to expose the seeds and pulp (p. 8, 67). Ants carried away the seeds [presumably with the funiculus, or seed stalk, attached] and later discarded intact seeds in refuse mounds (p. 67). Soil samples near live individuals averaged 18.36 seeds per square meter (m^2), and up to 50.72 seeds/m^2 occurred near clusters of 6 or more individuals (pp. 55–61). Seeds recovered from the soil were one or more years old, and from 40 to 51 percent of these seeds germinated (p. 49). In comparison, seeds collected from fresh fruits had lower germination rates, indicating that seeds are initially dormant (p. 66). The overall density of germinable seeds averaged 8.32/m^2. Emmett concluded that black lace cactus forms a persistent seed bank with a seed longevity of at least 1 year (p. 68).

Populations.

The 5-year review (USFWS 2009) indicates that 6 populations of black lace cactus have been found from east-central Jim Wells County to north-east Kleberg County to Refugio County (pp. 11–13). By 2009, only two extant populations were known, in Kleberg and Refugio Counties. The status of the Jim Wells population, last observed in 1989, was unknown (p. 5). All extant and historic populations occurred on privately owned land (p. 4). At the Kleberg site, 43,441 individuals were reported in 1983 and 19,250 in 1985. A large portion of the site was cleared in 1986. Since then, 13,250 individuals were reported in 1987, 1,160 in 2001, and 824 in 2002. Similarly, 82,500 individuals were reported from the Refugio County site in 1987 and 1,527 in 2004. The Jim Wells County population had about 16,000 individuals in one sub-population in 1985; a second subpopulation was cleared, but about 48 individuals survived. Although these population censuses did not use consistent methods, all populations have apparently declined.

In 2014, San Miguel Electric Cooperative, Inc. (SMECI) requested section 7 consultation with USFWS regarding proposed lignite mines in McMullen and Atascosa Counties. During a site visit, USFWS biologist Frank Weaver discovered a black lace cactus population along San Miguel Creek, a tributary of the Frio River, in northern McMullen County; the identification was confirmed by spine morphology (Best 2014) and flower color (see SMECI 2018a, figure 14). In subsequent surveys, consultants for SMECI documented a main population of 1,800 to 2,000 individuals in an area of 0.52 hectares (ha) (1.3 acres (ac)) along San Miguel Creek, and 145 individuals occurred in a separate area of 0.02 ha (0.05 ac) (SMECI 2018a, p. 4). Since the smaller population would be affected by proposed mining operations, 103 individuals were removed in 2015 and donated to South Texas Botanical Gardens and Nature Center in Corpus Christi. In 2017 and 2018, 42 remaining individuals were transplanted to the larger population area, which will not be affected by mining (pp. 4–5). Six of the transplanted black lace cactuses were killed, apparently by southern plains wood rats (*Neotoma micropus*), and 36 cactuses were alive up to 1 year after transplanting (p. 4). Consultants for SMECI also surveyed 194.3 ha (480.2 ac) of potential habitat on a separate mine permit area in adjacent Atascosa County, where they discovered several hundred black lace cactus individuals in an area of 1.5 ha (3.6 ac) along Metate Creek, a tributary of the Atascosa River (SMECI 2018b, pp. 2–3). This population occurs in sparse shrubland in association with halophytic plants, and apparently is occasionally flooded (p. 3). This population site will not be affected by mining operations (p. 4).

Terry (2017) reported that the phylogenetics investigators had found contact information for additional historic populations in La Salle and Jim Wells counties, and will attempt to survey those areas.

In summary, the populations in Kleberg and Refugio Counties appear to have declined over the last 30 years, but remain extant. The Jim Wells County population has not been observed in 30 years. Two new populations have been confirmed in northern McMullen County and a cluster of populations have been documented in southern Atascosa County.

Conservation efforts.

The 5-year review (USFWS 2009, p. 13) reported that several attempts at propagation and reintroduction had not been successful, or were not subsequently monitored.

In 2004 and 2006, TPWD botanists collected a total of 4,723 seeds from 36 fruits of black lace cactus from the Refugio County population for seed banking and propagation studies at Desert Botanical Garden (DBG, Phoenix, Arizona) (USFWS 2009, p. 6). Seedlings at DBG did not survive. However, TPWD provided a sample of these seeds to researchers in Germany, where they have been propagated and have flowered and produced several thousand seeds (Lange and Sinclair 2013, p. 76). The seeds produced in German refugia have retained viability in storage for 4 to 5 years.

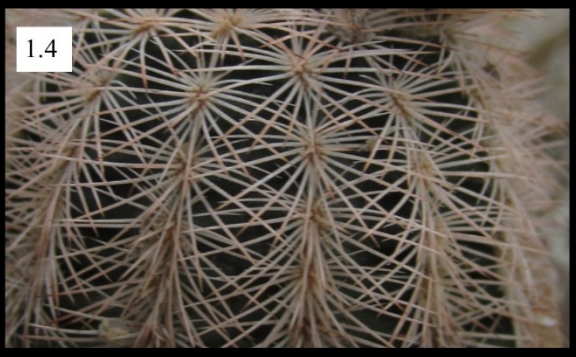
Williamson *et al*. (2016, pp 2–3) obtained permission from landowners of the Refugio, Kleberg, and McMullen sites to access and collect data from these populations. These investigators salvaged plants at each site that had been dug up by feral hogs; the salvaged plants are now maintained at the Sul Ross State University greenhouse to be used for further DNA sampling, seed production, and potentially for reintroduction. A systematic census at the Refugio site found 1,485 individuals in the main population, and 3 or 4 smaller colonies had not yet been censused. The investigators observed that cattle had uprooted 13 cactuses, and discussed with the landowner livestock management options that could reduce impacts to black lace cactus. No suitable habitats or black lace cactus populations were found during surveys of a 50,587-ha (125,000-ac) ranch in Duval County, an 809-ha (2,000-ac) ranch in McMullen County, and a 2,631-ha (6,500-ac) ranch in Bee County.

Threats.

The 5-year review (USFWS 2009) provides the most recent threats analysis. The clearing of native vegetation for row-crop farming or improved pasture has greatly reduced several known populations (p. 16), and potentially threatens all populations. All populations are affected by competition from introduced invasive grasses, including Kleberg bluestem (*Dichanthium annulatum*), King Ranch Bluestem (*Bothriochloa ischaemum*), coastal bermudagrass (a cultivar of *Cynodon dactylon*), guineagrass (*Megathyrsus maximus*), buffelgrass (*Pennisetum ciliare*), and carpetgrass (*Axonopus affinis*). The use of herbicides for brush control is a potential threat to all populations (p. 17). All populations are vulnerable to illicit collection, although this has not been observed (p. 17). Black lace cactuses are vulnerable to parasitism by an unidentified

moth and by *Chelinidea vittiger*, a species of leaf-footed bug (Coreidae) (pp 17–18). Uprooting by feral hogs and cattle trampling are both low intensity threats that affect all or most populations (pp. 17–18). The mounds of red imported fire ants cover individual plants, presenting a threat of undetermined severity to all populations. Many populations have declined in size and are now threatened by demographic and genetic consequences of small population sizes (p. 20). The potential impacts of pesticides on pollinators is an additional threat of unknown scope and severity. The potential effects of climate changes include higher temperatures, an increased frequency of severe weather, increased invasive grass and woody plant competition, increased wildfire, insect parasites, flooding, and sea level rise (pp. 21–24). Nevertheless, the overall effect of climate changes on black lace cactus are unknown.

Figure 1. Photographic images of black lace cactus and related species.



1.1 *Echinocereus fitchii* ssp *albertii*, Refugio Co.
1.2 *E. fitchii* ssp f*itchii*, Starr Co.
1.3 Spine clusters of ssp. *albertii*, Refugio Co.
1.4 Spine clusters of ssp. *fitchii*, Starr Co.
1.5 *E. reichenbachii* ssp. *caespitosus*, Bexar Co.
Taxonomy: Bloom *et al*. 2004
Photos: 1.4 Kim Wahl, USFWS; all others Chris Best, USFWS.

II. Methods used to revise the recovery criteria.

We reviewed information in our files and requested new information about black lace cactus from botanists at TPWD and researchers at academic institutions. The rationale we use here for establishing recovery criteria was developed through recommendations of the South Texas Plant Recovery Team for revising the recovery criteria of several listed plants in South Texas. The appointed members of this team include representatives from TPWD, The Nature Conservancy, the University of Texas Rio Grande Valley, Sul Ross State University, U.S. Department of Agriculture Natural Resources Conservation Service (NRCS), Texas A&M-Kingsville, Lower Rio Grande Valley National Wildlife Refuge, and private landowners. Independent peer review of this draft amendment will be conducted concurrent with publication of a Notice of Availability in the *Federal Register*.

III. Rationale for establishing the recovery criteria.

The USFWS bases assessments of species viability, defined as the likelihood of persistence over time, on analyses of a species' resilience, redundancy, and representation (Shaffer and Stein 2000, pp. 307—310; National Marine Fisheries Service and USFWS 2010, pp. 5.1-14–5.1-19). Therefore, recovery criteria should also address a species' resilience, redundancy, and representation. Resilience refers to the population size necessary to endure stochastic environmental variation (Shaffer and Stein 2000, pp. 308-310). Redundancy refers to the number and geographic distribution of populations or sites necessary to endure catastrophic events (Shaffer and Stein 2000, pp. 308-310). Representation refers to the extent of genetic and ecological diversity, both within and among populations, necessary to conserve long-term adaptive capability (Shaffer and Stein 2000, pp. 307-308).

III.a. Rationale for downlisting criteria. In this amendment, we base the criteria for downlisting to the threatened status on the minimum conditions necessary so that the species is no longer in danger of extinction, but is still likely to become endangered within the foreseeable future. These criteria are defined by minimum viable population (MVP) sizes, the number and distribution of populations, and the abatement of threats through the conservation and protection of populations and habitats. These criteria must specify which individuals can contribute to determinations of MVP, and must also describe when and how population sizes can be determined and how populations are to be delimited.

The metric for resilience is MVP, 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. The MVP has not been calculated for black lace cactus, nor do we possess all the baseline demographic and life history data needed to perform these calculations. Table 1 is an adaptation of a method for estimating plant MVPs published in Pavlik (1996, p. 137). 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 black lace cactus. Two factors require fewer individuals (perennial lifespan and climax successional status). Five

factors are intermediate or unknown. The growth form of this small columnar cactus is intermediate between herbaceous and woody plants. Its fecundity, discussed in section I.c, is in an intermediate range for plants. Ramets are individuals produced through vegetative reproduction (clones); ramets are apparent but not abundant in photographs of black lace cactus. The survivorship of individuals in the wild has not been studied. The longevity of seed viability in the soil is at least one year, and is at least intermediate compared to plants in general. Two factors require more individuals (outcrossing and high environmental variation (wide variation in annual precipitation)). The weighted average of these values is:

((2 x 50) + (5 x 1,000) + (2 x 2,500)) / 9 = 1,122.

On this basis, we provisionally estimate the MVP of about 1,100 individuals for black lace cactus, and adopt this value as the criterion of resilience for reclassification to the threatened status.

Table 1. Minimum viable population guidelines applied to black lace cactus (adapted from Pavlik 1996, p. 137).

Factor	A. MVP of 50 individuals for species with these traits.	B. Intermediate MVP of 1,000 individuals for species with intermediate or unknown traits.	C. MVP of 2,500 individuals for species with these traits.
Longevity	**Perennial**		Annual
Breeding System	Selfing		**Outcrossing**
Growth Form	Woody	**Intermediate**	Herbaceous
Fecundity	High	**Moderate**	Low
Ramet Production	Common	**Intermediate**	Rare or None
Survivorship	High	**Unknown**	Low
Longevity of Seed Viability	Long	**Moderate**	Short
Environmental Variation	Low		**High**
Successional Status	**Climax**		Seral or Ruderal

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 juvenile cactuses often have high mortality rates, and juveniles that die before they reproduce do not contribute to the effective population size or future genetic diversity. Basing the criterion on mature individuals will also make it easier to judge when the criterion has been met, since population surveys that do not distinguish mature plants from juveniles would appear to fluctuate wildly, depending on how recently seeds had germinated and the proportion of surviving seedlings. Population censuses should be conducted during the season of peak flowering and fruiting (mid-April through May), since the species is most easily detected when flowering, and to distinguish mature individuals from juveniles.

The metric of redundancy is the number and distribution of populations. We are not aware of a scientific method to determine the minimum number of populations needed to assure long-term survival of a species; relatively large numbers of protected populations distributed over a wider geographic range confer greater redundancy. The criterion of redundancy for endangered plant recovery typically ranges from 5 to 20 populations; species that form stable, long-lived populations can be secure with fewer populations, and species with unstable, short-lived populations require greater redundancy. The decline and loss of many of the known populations suggest that black lace cactus populations are vulnerable and short-lived, or they may migrate within areas of potential habitat. However, due to the loss and fragmentation of potential habitats, the species is less able to colonize new habitats. Based on these factors, we provisionally estimate that the recovery of black lace cactus requires at least 10 viable populations overall.

The metric of representation is derived from the geographic distribution of populations as well as the genetic variation within and between populations. To conserve the full range of the species' genetic diversity and ecological adaptation, it must be conserved throughout its geographic range. Since black lace cactus populations are more likely to disperse along watercourses than between them (discussed below), we have tentatively identified three recovery units representing the watersheds where the species has been documented (Figure 2). These recovery units occur in the following watersheds:

1. Aransas River, Mission River, Medio Creek, Blanco Creek, Melon Creek, Chiltipin Creek, and their tributaries; primarily in Refugio, San Patricio, and Bee Counties.

2. Lower Nueces River, Lower Frio River, San Miguel Creek, Metate Creek, Atascosa River, Borrego Creek, La Parita Creek, and their tributaries; primarily in Atascosa, McMullen, Live Oak, northern Jim Wells, and along the Nueces River in San Patricio and Nueces Counties.

3. San Fernando Creek, Rosita Creek, San Diego Creek, Amargosa Creek, Santa Gertrudis Creek, Jaboncillos Creek, and their tributaries; primarily in Kleberg, southwest Nueces, Jim Wells, and eastern Duval Counties.

These tentative recovery units may be revised if new data on the species' distribution, population genetics, or ecological adaptation indicate more logical delineations. To increase redundancy within recovery units, each unit must have at least three viable populations.

In order to apply the criteria of population size, number, and distribution, it is necessary to delineate populations. As used here, a population consists of groups of individuals within which gene flow, by means of seed dispersal, pollination, or the translocation of intact individuals, occurs often. Metapopulations refer to two or more populations between which gene flow occurs infrequently. Separate groups of individuals between which gene flow does not occur constitute separate populations. Viable populations of rare plants often consist of metapopulations of numerous small populations that each migrate through areas of contiguous habitat, periodically merging or dividing over spans of many years. We hypothesize that black lace cactus may also follow this pattern. Therefore, the recovery criteria may be applied to metapopulations as

defined here. Since seed dispersal appears to have a very limited range, gene flow of black lace cactus is limited by the forage range of its pollinators (described in Section I.c); additionally, intact individuals and viable seeds may be occasionally carried by flood waters to establish new colonies downstream. For this reason, colonies dispersed along a single watercourse are likely to pertain to a single metapopulation. Based on the likely range of pollinators, groups of individuals separated by distances greater than 5 km (3 mi), or distributed along separate watercourses, may be considered separate populations or metapopulations.

Successful management and conservation could result in multiple viable populations expanding until they coalesce into larger populations. This improvement in the species' viability would nevertheless appear to reduce the number of viable populations, making it more difficult to meet the downlisting criteria. Therefore, for the purpose of determining the fulfillment of these criteria, previously separate viable populations that expand and merge into larger populations may continue to be tracked as separate populations.

The long-term viability of populations requires that they are protected from development and other threats, and are managed in a manner that promotes the species' conservation. There are few publicly-owned lands within the geographic range of black lace cactus. However, protection and management may be accomplished through conservation easements or long-term conservation agreements with private landowners.

III.b. Rationale for delisting criterion. The delisting criterion (for removal from the list of threatened and endangered species) consists of attaining the downlisting criteria levels described above and sustaining or improving this status long enough to demonstrate that black lace cactus is no longer likely to become endangered in the foreseeable future. This will require a defined period of monitoring that is long enough to detect demographic trends and responses to climate changes, and to distinguish the longer-term trends from periodic fluctuations driven by variations in annual rainfall. We provisionally estimate that at least 5 generation spans are needed to detect demographic trends. A generation span is the time required for a newly-dispersed seed to germinate, grow to a reproductive size, flower, and produce viable seeds. Although we do not know how long the generation span is for black lace cactus, based on other South Texas cactus species that have similar sizes and life histories, this is likely to be from 5 to 10 years. Therefore, when all downlisting criteria have been met, black lace cactus may be delisted when these criteria are sustained or improved for at least 25 years.

IV. Amended Recovery Criteria.

a. Downlisting Recovery Criteria. Justifications for all downlisting criteria are described in Section III.a.

1. Black lace cactus is documented in 10 or more protected, viable populations, with at least 3 viable populations in each of 3 recovery units. Populations and metapopulations are delineated by unpopulated gaps of at least 5 km (3 mi). However, as described in Section III.a., viable populations that expand and merge with other populations may be considered separate populations for the purpose of meeting this criterion.

2. Viable populations have 1,100 or more mature individuals. Mature individuals have flowered at least once or are judged capable of flowering. Population censuses should be conducted during the peak of flowering and fruiting, from mid-April through May.

3. Protected populations occur on lands that are legally protected and managed to conserve the region's native flora and fauna, including black lace cactus and its habitats. Examples include, but are not limited to, conservation easements on private lands, lands owned and managed for conservation by non-profit organizations, publicly-owned land managed for conservation purposes, and legally binding long-term management agreements with private landowners.

b. Delisting Recovery Criterion. Justifications for all delisting criteria are described in Section III.b.

1. Periodic monitoring indicates that the downlisting criteria have been met, and that demographic trends have subsequently remained stable or have increased over a period of 25 years.

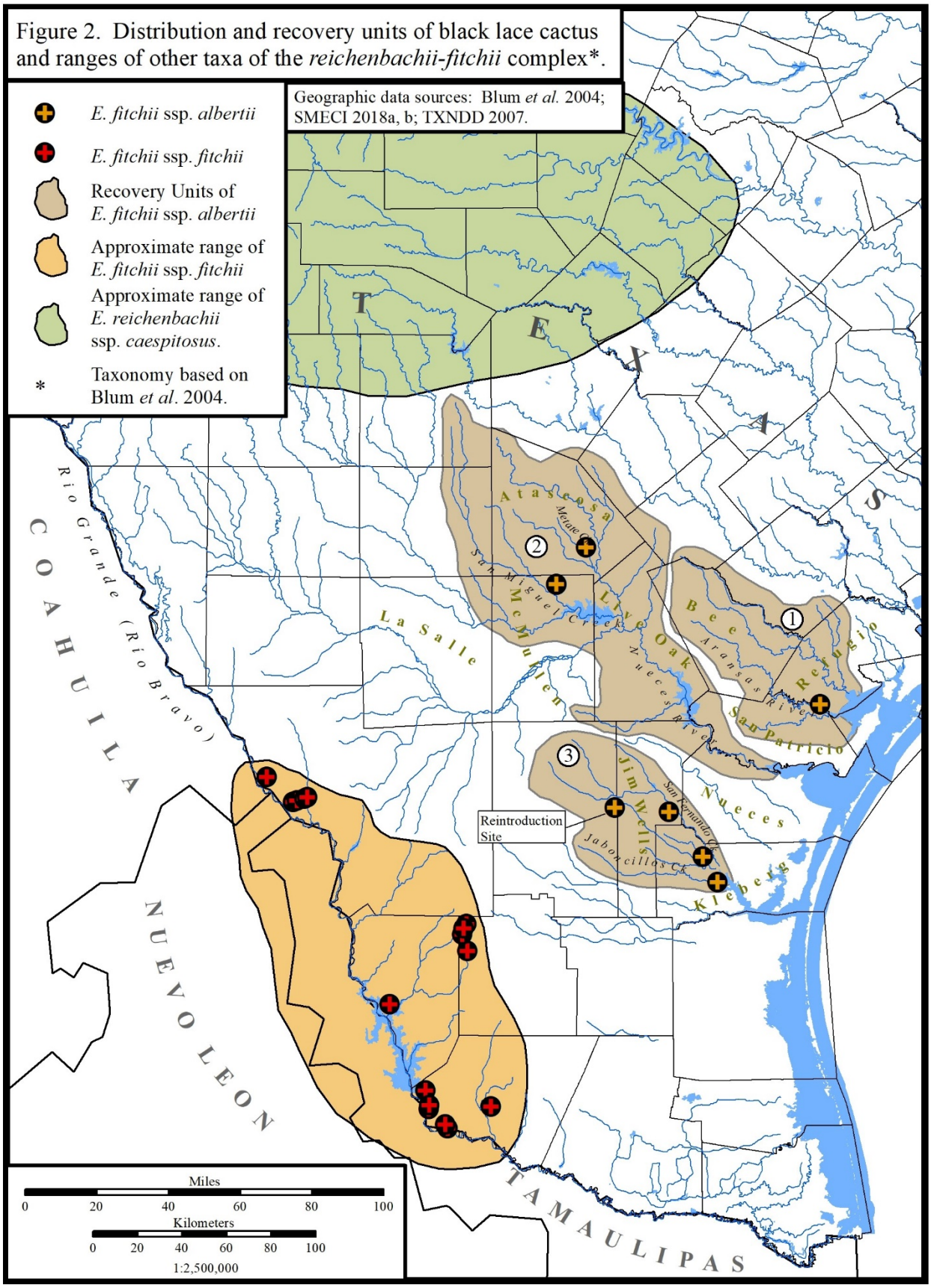


Figure 2. Distribution and recovery units of black lace cactus and ranges of other taxa of the *reichenbachii-fitchii* complex*.
E. fitchii ssp. albertii
E. fitchii ssp. fitchii
Recovery Units of E. fitchii ssp. albertii
Approximate range of E. fitchii ssp. fitchii
Approximate range of E. reichenbachii ssp. caespitosus.
* Taxonomy based on Blum et al. 2004.
Geographic data sources: Blum et al. 2004; SMECI 2018a, b; TXNDD 2007.
TEXAS
COAHUILA
NUEVO LEON
TAMAULIPAS
Rio Grande (Rio Bravo)
La Salle
Atascosa
McMullen
Live Oak
Bee
Refugio
San Patricio
Jim Wells
Nueces
Kleberg
Reintroduction Site
1
2
3
Miles
0 20 40 60 80 100
Kilometers
0 20 40 60 80 100
1:2,500,000

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