

Black Lace Cactus
(*Echinocereus reichenbachii* var. *albertii*)

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



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

5-Year Review
Black lace cactus (*Echinocereus reichenbachii* var. *albertii*)

1.0 GENERAL INFORMATION

1.1 Reviewers

Lead Regional Office: Southwest (Region 2), Wendy Brown, Endangered Species Recovery Coordinator, (505) 248-6641; Brady McGee, Regional Recovery Biologist, (505) 248-6657.

Lead Field Office: Corpus Christi Ecological Services Field Office, Amber Miller and Robyn Cobb, Fish and Wildlife Biologists, (361) 994-9005 ext. 262 and 241.

Cooperating Field Office: Austin Ecological Services Field Office, Chris Best, Texas State Botanist, (512) 490-0057 ext. 225.

1.2 Methodology used to complete the review:

This review was conducted through public review notification and a comprehensive review of all documents regarding black lace cactus (BLC) that were available in the U.S. Fish and Wildlife Service's (Service) Corpus Christi Ecological Services Field Office (CCESFO). The Federal Register notice announcing this review published on April 21, 2006, and solicited new information from Federal and State agencies, non-governmental organizations, academia, and the general public. All information received, along with scientific information from Service files, the recovery plan, section 7 consultations, the State of Texas' Natural Diversity Database (formerly known as the Biological Conservation Database), unpublished reports, monitoring reports, conversations with and comments from biologists familiar with the species, and information available on the internet, was used in the preparation of this document. This document was drafted by staff in the CCESFO. Due to questions regarding the taxonomy of this subspecies, Steve Chambers, Senior Scientist for the Service's Southwest Region, reviewed the taxonomic section of this document.

1.3 Background:

1.3.1 FR Notice citation announcing initiation of this review:
71 FR 20714; April 21, 2006

1.3.2 Listing History

Original Listing

FR notice: 44 FR 61918.

Date Listed: October 26, 1979

Entity Listed: *Echinocereus reichenbachii* var. *albertii*

Classification: Endangered without Critical Habitat.

1.3.3 Associated Rulemakings: None.

1.3.4 Review History:

A 5-year review was initiated on July 22, 1985 (50 FR 29901) for all species listed before 1976, and in 1979-1980; a notice of completion with no change in status was published on July 7, 1987 (52 FR 25522).

Another 5-year review was initiated on November 6, 1991 (56 FR 56882) for all species listed before 1991, but no document was prepared for this species.

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

Species are given a priority number ranging from 1 to 18 based upon degree of threats, recovery potential, and taxonomic distinctness (48 FR 43098). The BLC's Recovery Priority Number is 3, meaning that the level of threat is high, the recovery potential is high, and the listed entity is a subspecies.

1.3.6 Recovery Plan or Outline

Name of Plan: Black Lace Cactus (*Echinocereus reichenbachii* var. *albertii*) Recovery Plan

Date Issued: March 18, 1987.

Dates of previous revisions, if applicable: No subsequent revisions have been made to the original recovery plan.

2.0 REVIEW ANALYSIS

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

2.1.1 Is the species under review a vertebrate?

No. The Endangered Species Act (Act) defines species to include any distinct population segment of any species of vertebrate wildlife. This definition limits the listing of distinct population segments (DPS) to only vertebrate species of fish and wildlife. Because the DPS policy is not applicable to this plant species, the policy is not considered further in this review.

2.2 Recovery Criteria

2.2.1 Does the species have a final, approved recovery plan?

Yes, the BLC has a final, approved recovery plan (USFWS 1987).

2.2.1.1 Does the recovery plan contain objective, measurable criteria?

The BLC has a final, approved recovery plan that includes one objective, measurable criterion for downlisting to threatened status. When the recovery plan was finalized in 1987, limited data made it impossible to quantify habitat and abundance requirements with enough precision to establish further recovery criteria and none were established for delisting the species.

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?

No. The recovery plan has one criterion for downlisting and does not address delisting. The downlisting recovery criterion was developed at the time the recovery plan was written in 1987, and therefore does not reflect any information gathered since that date.

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.

The sole recovery criterion for changing the status of BLC from federally endangered to threatened depended on establishing permanent protection of two or more of the extant populations at the population levels known in 1987 (USFWS 1987). This permanent protection has not been accomplished at any of the population sites as all of the sites remain in private ownership with no type of conservation easements in place. Although two of the landowners were identified, cooperative management agreements were never arranged. Development of land management and use protocols, additional searches for new populations, and initiation of biological and ecological studies were not systematically undertaken because of budgetary and personnel limitations. Contact with the landowners at two of the population sites, in Refugio and Kleberg Counties, has been sporadic although both of these sites have been visited multiple times between 1987 and 2006 (see following sections on Biology, Habitat, and Threats).

2.3 Updated Information and Current Species Status

2.3.1 Biology and Habitat

2.3.1.1 New Information on the species' biology and life history:

As of 2007, two populations of BLC were known to be extant in Refugio and Kleberg Counties. The continued existence of a population in Jim Wells County is also possible (Figure 1). Subsequent to the approval of the recovery plan in 1987, biological information about the BLC has come primarily from seed collection, germination, and establishment work.

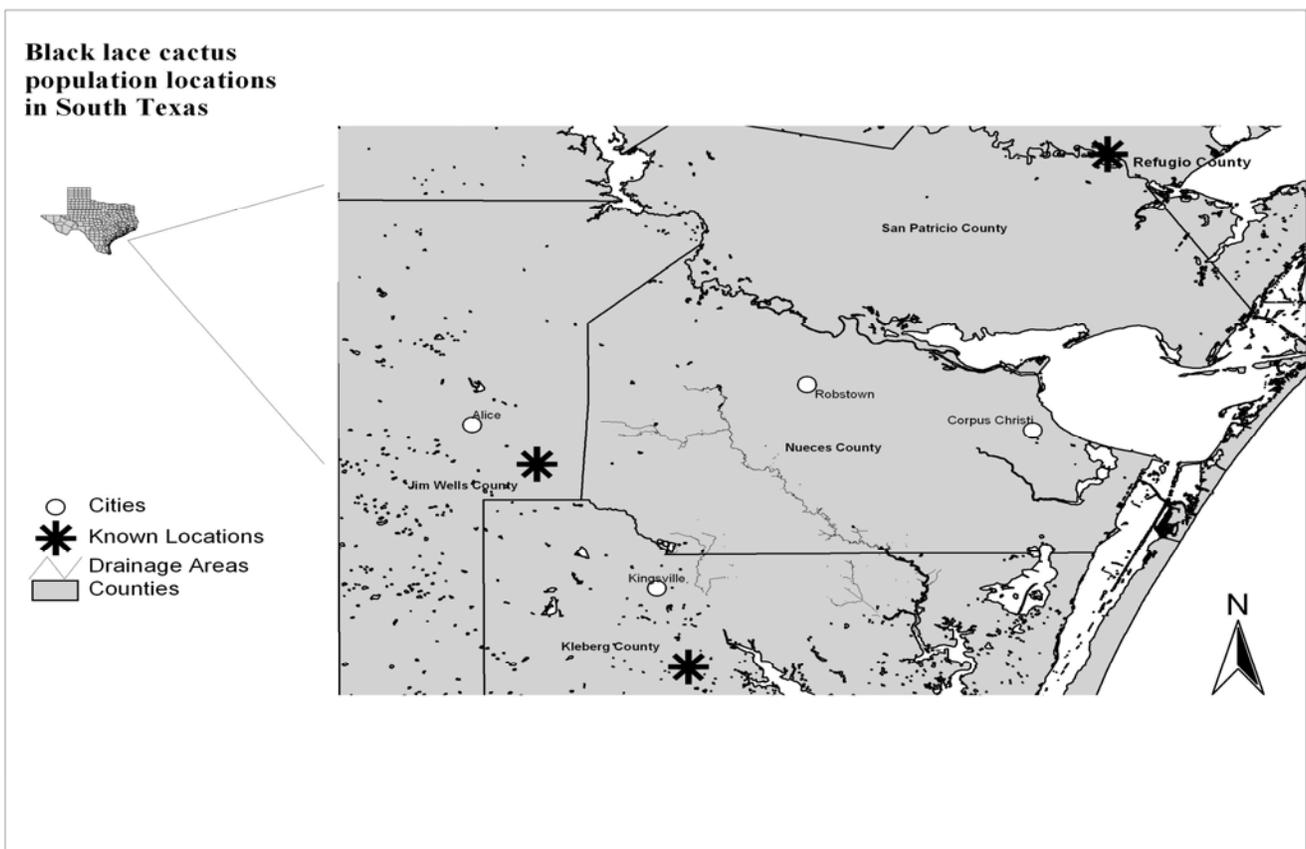


Figure 1. Populations of Black lace cactus found in Jim Wells, Kleberg, and Refugio Counties.

In 1987, and again in the spring of 1988, cuttings of varying diameters were taken by Corpus Christi Botanical Garden (CCBG) staff from a few BLC in the Kleberg County population. These crowns were subsequently dried and rooted, and in both years the crowns flowered and set seed. One of the crowns collected in 1987 produced 300 seeds (Bush 1990). These

1988 Kleberg County cuttings were rooted; they then flowered, set seed, and germinated, producing numerous seedlings. In 1989, 61 seedlings were collected by the CCBG from the Refugio County population (Bush 1990, also R. Cobb, note to file, 2008). Seeds from these plants were germinated at the CCBG; however, none were seed banked with other institutions (Bush pers. comm. 2008). Seedlings from both populations were planted into pots and split into two treatments, full sun and some shade, but both groups declined in numbers due to desiccation within the under-sized pots and also from packrat (*Neotoma* sp) herbivory (Bush 1990, C. Bush, pers. comm. 2008). In 1990, representatives from both cactus populations were planted into a mesquite-garden area on the CCBG grounds and were reported as extant as late as August of that year.

In 2004, the Texas Parks and Wildlife Department (TPWD) recovered 2,143 seeds from 24 fruits produced at the Refugio population site (D. Price, pers. comm. 2004). Seeds from each fruit were stored separately per the Desert Botanical Garden's (DBG) standard protocol. Seeds were desiccated at approximately 67°F and 30% relative humidity. The DBG conducted an initial germination test on the seeds beginning in July 2004 and ending in September 2004; however, seedlings from the 2004 germination studies did not survive (K. Rice, pers. comm. 2008). No subsequent seed collection from wild populations took place for seed banking purposes until 2006 when 2,580 seeds were collected from 12 Refugio County BLC fruits (D. Price, pers. comm. 2007). These seeds are being maintained at the DBG in Phoenix in long-term frozen storage at 20°C and eventually will be used for reintroduction of species (K. Rice, pers. comm. 2006; D. Price, pers. comm. 2007; K. Rice, pers. comm. 2008). The TPWD was working to assist German researchers to obtain Convention on International Trade in Endangered Species (CITES) permits for additional taxonomic work on seeds and spines; however, this work has not yet occurred because CITES permit issues have not yet been resolved (D. Price, pers. comm. 2007).

The species' recovery plan objectives included cultivation of stocks for commercial distribution, as well as seed collection to aid in propagation studies (USFWS 1987). The development of seed stock by authorized, responsible, and/or licensed agencies was considered a potentially practical method of reducing collection pressures (USFWS 1987). The CCBG indicated their belief that they had developed several propagation techniques that would work for the BLC, including crown cuttings and seeding. Although the recovery plan called for adding more specimens to herbariums to allow further reproductive work on the species, only one specimen, collected from Refugio County, is currently housed in the DBG in Phoenix, Arizona. Two additional BLC individuals were salvaged and shipped to the San Antonio Botanical Gardens (SABG) for conservation

purposes after they were found, apparently uprooted by feral hogs, at the Refugio County site (D. Price, pers. comm. 2004).

Most aspects of the reproductive biology and ecology of the BLC have not been thoroughly studied. The species is known to flower from March through June, with a peak flowering period of mid-April to early May. However, in 2006 the Refugio County population flowered into July (D. Price pers. comm. 2006). Although pollinators have not been researched, bees and wasps have been observed visiting flowers. Seeds fall to the ground or are washed down by rainfall as the seed decomposes. Emmett's (1989) study of BLC seed reserves showed the species maintaining a soil seed reserve with some viable seed for at least one year. Seed dispersal mechanisms are thought to be unspecialized, but native ants have been observed mining BLC seeds, carrying them back to their mounds, and then discarding the seeds outside of the colony (United States Department of Agriculture [USDA] 1996). Other seed-dispersal mechanisms may include fur-bearing mammals inadvertently picking up seeds in their hair as they pass cacti flowers or flooding. Feral hogs may also help to disperse seeds through their rooting activities (USDA 1996).

2.3.1.2 Abundance, population trends, demographic features, or demographic trends:

When BLC was listed in 1979, counts of individuals had been documented for the three population sites that were extant at that time (USFWS 1987). Between 1965 and 2006, numbers of individual plants were reported by a number of surveyors (Table 1), however neither comprehensive counts of individual plants or systematic sampling procedures have been conducted at any of the three population sites in a repeated fashion, making comparisons between years difficult. Subsequent to the publication of the recovery plan in 1987, overall declines in individual plant counts were seen at all three sites due to habitat destruction, mainly from brush clearing, and from conversion to improved pasture planted to non-native coastal grasses such as Coastal Bermuda grass (*Cyanodon dactylon*) (USFWS 1987).

For the Kleberg County population, individual plant counts in 1983 consisted of 41,303 and 2,138 individuals in the scattered subpopulations that make up this site (TNDD 2007). In 1985, J. Poole, TPWD, estimated a total of 19,250 individuals for this population (D. Price, pers. comm. 2007, TNDD 2007). In 1986, a large portion of this Kleberg County site was destroyed by brush clearing (USFWS 1987). The BLC Recovery Plan documents a total of 13,250 individuals counted at the Kleberg County site in 1987 (USFWS 1987). A two-hour census of this population in 2001 produced a count of only 1,160 plants, and in 2002, only 824 plants were located at the site (D. Price, pers. comm. 2007). Sampling methods were

not comparable between surveyors, therefore reported declines in this population may have resulted in part from brush clearing, but the lack of continuity and intensity in sampling techniques may have also contributed to the diminished counts. For example, two German *Echinocereus* researchers, visiting this population in May 2006, noted that the BLC plants were difficult to find and numbered in the dozens rather than the hundreds or thousands, but this observation was anecdotal and not based on a systematic count of individuals or a sampling of the population during this site visit (D. Price, pers. comm. 2007).

When the recovery plan was finalized in 1987, approximately two dozen plants remained at the first reported Jim Wells County BLC site (USFWS 1987). Weniger (1979) reported a second subpopulation in Jim Wells County that he considered likely to be an extension of the first known population. He described this subpopulation site as being completely undisturbed as of October 1985 (USFWS 1987). A conservative estimate of 16,000 BLC individuals was counted within the second site where the plants were located in more densely vegetated cover as opposed to open areas. It appeared that the dense vegetation may have offered protection from trampling by livestock or from other natural threats (USFWS 1987). There is no recent documentation of numbers or condition of plants at the Jim Wells population site since the last reported site visit in 1989 (D. Price, pers. comm. 2007).

The Refugio County site was described as a scattered population, with the cacti more densely concentrated in some areas than in others (USFWS 1987). In 1986, an average of 4.25 plants per square meter was estimated with the most densely populated area containing approximately 82,500 BLC plants (USFWS 1987). A 2004 census of this population resulted in counts of 1,527 clumps and 5,524 stems, with the clumps of BLC assumed to be distinct individuals (D. Price, pers. comm. 2007). Although it appears that BLC numbers at the Refugio County site may be declining, survey efforts have not been consistent in methodology or frequency. The landowners are aware of the species, have allowed TPWD and the Service access, and are amenable to conservation suggestions (Carr 2003).

Sites	1965 - EOC #1	1979 Final Rule	1980 Dr. Albert	1983 - EOC #3	1985 EOC #3 (Poole)	1986 - EOC #5 (Poole)	1987 Recovery Plan	2001 - Price, Hempel, Pressley	2002 - Price, Hempel	2003 - Carr	2004 - Price, Carr, Hempel	2006 - Price, Germans
Jim Wells Co., #1							4 groups of 4-12 plants each (48max)					
Jim Wells Co., #2							16,000 of all age groups					
Kleberg Co., #1				41	19,250*			1,160*	824*			dozens*
Kleberg Co., #2				303								
Kleberg Co., #3, stand 1 and 2				2,138			3,000 plants- both stands					
Kleberg Co., #3, stand 3							2,250 plants					
Kleberg Co., #3, stand 4							8,000 plants					
Refugio Co., #1	several hundred					82,500*				hundreds	1,527 clumps* and 5,542 stems	
Duval Co. (Introduced site)			24 plants									
Totals:	several hundred	4,000	24 (not extant)	2,482	19,250	82,500	29,298	1,160	824	hundreds	1,527	dozens

Table 1. Numbers of BLC plants found at all known population sites.

2.3.1.3 Genetics, genetic variation, or trends in genetic variation:

The BLC recovery plan called for determination of genetic relationships between *Echinocereus reichenbachii* var. *albertii* and other related taxa (USFWS 1987); however, no new genetic information for BLC has been obtained. In 2006, two German *Echinocereus* researchers accompanied a TPWD botanist to the Refugio County population site where spines and seeds of *E. reichenbachii* var. *albertii* were collected. This material was intended for use in diagnostic testing to examine differences among the spine and seed features of the *E. reichenbachii* complex, including *fitchii*, *albertii*, and other species. Within this complex, there are many similarities between the varieties, contributing to the taxonomic confusion (D. Price, pers. comm. 2006). The seeds collected in 2006 have not yet been shipped to Germany due to CITES permit delays (D. Price, pers. comm. 2006).

2.3.1.4 Taxonomic classification or changes in nomenclature:

The scientific name for BLC is *Echinocereus reichenbachii* (Terscheck) F. Haage var. *albertii* L.D. Benson. This variety was described from a specimen collected in 1965 in Jim Wells County (USFWS 1987). Some disagreement exists about the taxonomy of the group of *Echinocereus* with large pink flowers, and there are several synonyms for BLC, including *E. melanocentrus* (Lowry) and *E. fitchii* (Britton and Rose) subspecies *albertii* (L. D. Benson) W. Blum and Mich. Lange (Poole et al. 2007) (Table 2). Some cacti specialists lumped the BLC variety *albertii* with a very similar counterpart, *E. reichenbachii* var. *fitchii*. Blum et al (1998) recognized the taxon *albertii* but placed it within the species *fitchii* as a subspecies (*E. fitchii* ssp *albertii*). Others have called it a separate subspecies (Poole et al. 2007). There are distinct morphological differences between *E. reichenbachii* var. *albertii* and *E. reichenbachii* var. *fitchii*. *Echinocereus reichenbachii* var. *fitchii* has 4-7 central spines of a brownish-red color while the variety *albertii* (BLC) has 0-1 central spines (except the Refugio County population that lacks a central spine) and appears more blackish in coloration (Poole et al. 2007). These two varieties are also geographically disjunct, with *E. reichenbachii* var. *fitchii* occurring in thorn shrublands atop limestone soils, calcareous sandy loams, or saline clays in Jim Hogg, Starr, Zapata, and Webb Counties, and in Mexico, while *E. reichenbachii* var. *albertii* grows on sandy soils in Refugio, Jim Wells, and Kleberg Counties (Poole et al. 2007). Even with these distinctions, Zimmerman and Parfitt (2003) did not recognize any varieties of *E. reichenbachii*, in part due to the interfertile nature of the taxa, and also due to pure populations not existing sympatrically (Poole et al. 2007). Poole et al. (2007) pointed out that many geographically isolated taxa have not developed genetic barriers and therefore, when placed in contact with cacti of the same origin, can cross freely.

Zimmerman and Parfitt (2003) described the taxonomic boundaries of infraspecific taxa, or varieties, of *E. reichenbachii* as "nebulous and controversial." They found *E. reichenbachii* var. *albertii* to be intermediate between var. *caespitosus* and var. *fitchii*. Although their position on *E. reichenbachii* varieties did cast some doubt on the taxonomic standing of *E. reichenbachii* var. *albertii*, they did not take the step of formally placing it in the synonymy of another variety. *Echinocereus reichenbachii* var. *albertii* was listed as endangered by both the Federal government and the State of Texas based on recognition of the taxon being a distinct variety, and TPWD and the Service continue to recognize this as a separate and valid entry (Poole et al. 2007).

Synonyms	Assigner	Year collected	Comments & Additional Citations
<i>E. reichenbachii</i>	(Terscheck) F. Haage	1893	Zimmerman and Parfitt (2003) did not recognize this plant with any subsequent varieties (Poole et al. 2007). TROPICOS online
<i>E. melanocentrus</i>	Lowry	1936	Nomenclature invalid (<u>Nomen nudum</u>). Taylor 1985, USFWS 1987
<i>E. reichenbachii</i> var. <i>albertii</i>	L. Benson [more correctly labeled as: (Terscheck) Haage, L. Benson]	1969	Found from Jim Wells Co., 1965; Federal and State agencies recognize this as a valid entry. Correll & Johnston 1970, Taylor 1985, TROPICOS online, Poole et al. 2007
<i>E. reichenbachii</i> var. <i>fitchii</i>	(Britton & Rose) Benson		Some cacti enthusiasts sink var. <i>albertii</i> in <i>fitchii</i> (Taylor 1985, Anderson 2001); from Webb, Jim Hogg, Starr Counties, Texas Correll & Johnston 1970, Poole et al. 2007
<i>E. reichenbachii</i> subsp. <i>fitchii</i>			Listed as endangered due to belief that <i>E. reichenbachii</i> var. <i>albertii</i> is a synonym Poole et al. 2007
<i>E. reichenbachii</i> subsp. <i>albertii</i>	(L. D. Benson) W. Blum and M. Lange		Poole et al. 2007

2.3.1.5 Spatial distribution, trends in spatial distribution, or historic range:

Historically, the BLC occurred in six scattered localities on the flat coastal plains in, or nearby to, dense brush habitat. Brush clearing and collecting led to a loss of habitat and a reduction in the species' range to three remaining sites, one each in three separate counties (USFWS 1979) (Figure 1). The historic range of BLC, based on known populations, extends from east-central Jim Wells County on the most southwestern edge of the range to northeastern Kleberg County near Ricardo at the most

southeastern point, and up to southern Refugio County at the most northern extent. This range encompasses parts of Jim Wells, Kleberg, Nueces, San Patricio, and Refugio Counties.

The first documented BLC population site in Kleberg County was located along Jaboncillos Creek. This site was destroyed by brush clearing and was later planted with Coastal Bermuda grass (USFWS 1987). A second population in Kleberg County was subsequently located along the south side of a broad swale of the same creek approximately six miles southeast of Ricardo. The Kleberg County population was still extant through 2006, which was when the last documented site visit occurred. A description of the population's condition during that 2006 site visit indicated that the site was being overrun by non-native invasive grasses as well as native shrubs (D. Price, pers. comm. 2006).

The Jim Wells population occurred as two scattered patches, one adjacent to San Fernando Creek and the other approximately half a mile south across the creek in an undisturbed area. The second site, discovered by Dr. R. O. Albert, a local physician and amateur naturalist, was considered likely to be an extension of the first population and covered approximately 1.5 ha (3.7 acres) (USFWS 1979). The habitat at the first site was totally bulldozed and all BLC plants were lost (USFWS 1987). However, Gardner and O'Brien, botanists and authors of the species' recovery plan, described finding at least four surviving groups of four to 12 plants each in an approximately 300 meter square patch of low, open brush adjacent to the bulldozed field (USFWS 1987). The second area was grazed and anecdotal observations described disturbances to the natural habitat at this site and decreases in the BLC population there (USFWS 1987). Conversion of land cover for agricultural purposes and brush clearing using herbicides were listed as potential causes for the decline of this BLC population (Ballew 1989). Populations of BLC in Jim Wells County have not been revisited nor landowner contact made since 1989, therefore no further census of this population has been undertaken (D. Price, pers. comm. 2007). The owners of this property did not reside on site and contact with them was not maintained by agencies or conservation groups in the years following development of the recovery plan. An attempt was made to locate this landowner in 2008 and to solicit interest in the species' conservation, but no response was forthcoming.

The Refugio County population was first documented in 1974 by F. B. Jones, local botanist and author of *The Flora of the Texas Coastal Bend*, who did not record plant abundance or the areal extent of the population at that time (USFWS 1987). In the BLC Recovery Plan, this population is described as being large but patchy, and scattered over approximately 17 ha (42 acres) adjacent to the Aransas River. The distribution of BLC at this site was considered dense over a part of the site and sparse in other

parts. The plants in this population were narrower and less robust than in the Jim Wells or Kleberg County populations. Several dead plants and a smaller proportion of juvenile plants were seen here than in the other populations and the mature plants were highly branched (USFWS 1987). A census was conducted in 1986 and the population was estimated at 82,500 individuals, most being mature plants (TNDD 2007). Although brush was cleared from this tract to enhance cattle grazing and improve deer hunting, management and protection measures for BLC were not undertaken (Ballew 1989). Based on a 2004 survey, this population appears to be declining in numbers of individual BLC plants, however distribution of the plant at this site, as well as areal extent of the population, does not appear to have changed.

Searches for additional BLC populations have taken place as part of section 7 consultations for a variety of actions, and the BLC has been included by the Nature Conservancy of Texas (TNC) as a target species for plant surveys in the Refugio-Goliad Prairie, but to date no additional populations have been located (Berger 2006, D. Price, pers. comm. 2008). In April and June of 2003, the Texas Department of Transportation (TxDOT) contracted BLC presence/absence surveys along proposed project routes in Refugio and Jim Wells Counties but no BLC individuals were located in these project areas (Ashley 2006).

Dr. Albert attempted to introduce specimens into two sites in Jim Wells County, but long-term success of those efforts is unknown. The BLC was also introduced into habitat described as “mesquite-mixed brush shrubland” at a site owned by the TNC in Duval County, but this effort was unsuccessful and Duval County is not considered an extension of the range (TNDD 2007).

In the late 1980’s, the CCBG used seeds from the Refugio population for germination and establishment at the CCBG location in Nueces County. The CCBG successfully germinated seeds and planted seedlings in the native plant area of the garden, but these also did not survive long-term (Bush 1990; R. Cobb, pers. comm. 2008).

2.3.1.6 Habitat or ecosystem conditions:

Black lace cactus is a small, columnar-shaped, pink-flowering cactus that occurs in a scattered fashion in open areas between vegetation and is known only from the Gulf Coastal Plain, occurring between coastal grasslands and Rio Grande plain shrub (Emmett 1989). The BLC Recovery Plan characterized BLC habitat as openings in mesquite brush occurring along streams of the coastal plain at 50 meters or less in elevation. The five counties over which the BLC may potentially occur offers a large geographic expanse with potential for additional

populations. At each of the known population sites, populations do not fill the apparent potential habitat (USFWS 1987).

This species is found in the vicinity of dense brush, but grows in mostly open, unshaded areas (Weniger 1979). Habitat can also occur on grasslands, thorn shrublands, and/or mesquite woodlands, with the BLC thriving on saline soils in coastal prairies (Poole et al. 2007). The BLC is frequently associated with a mixed shrub community consisting of woody species like mesquite (*Prosopis glandulosa*), huisache (*Acacia farnesiana*), blackbrush (*Acacia rigidula*), spiny hackberry (*Celtis ehrenbergiana*), Brasil (*Caesalpinia violacea*), lotebush (*Ziziphus obtusifolia*), wolfberry (*Lycium berlandieri*), Guayacan (*Guaiacum angustifolium*), Texas pricklypear (*Opuntia engelmannii* or *Opuntia lindheimeri*), tasajillo (*Opuntia leptocaulis*), and grasses such as Arizona cottontop (*Digitaria californica*), and plains bristlegrass (*Setaria vulpiseta*). Because the BLC often grows with a number of halophytes, it is thought to be adapted to saline soils.

All known population locations are within several hundred meters of a water source, such as Jaboncillos Creek or the Aransas River. The climate of this region is subtropical and semiarid, with an average annual temperature of 72°F and rainfall between 28-30 inches per year (Emmett 1989). According to Weniger (1979), BLC are typically found in stands consisting of numerous individuals.

At the extant Kleberg County population site, BLC occurs in several dense stands growing alongside Jaboncillos Creek in an area that was formerly sparsely vegetated. Sandy loam soils dominate at this site and the BLC grows in exposed locations among grass and herbs, and under shrubs and prickly pear cactus (USFWS 1987). Habitat appears to be tidally influenced by nearby Jaboncillos Creek, as evidenced by a halophytic plant community that intergrades into a mesquite brushland (Ballew 1989). The 1987 recovery plan indicated that a high proportion of surveyed plants at this site were old, branched specimens, while younger plants, although present, were less concentrated than was seen in the Jim Wells population (USFWS 1987).

The BLC population in Jim Wells County historically grew on both sides of San Fernando Creek. On one side of the creek, the BLC grew among other low plants and/or under a sparse canopy of small shrubs. This site was grazed and trampling of the species by cattle was observed in areas where cacti were not protected under small shrubs (USFWS 1987).

The Refugio County population occurs in an area described as level, open mesquite brushland atop sandy loam soil with some clay and scattered patches of whitish sand” (TNDD 2007). The BLC at this site is associated

with an open brush habitat, salt tolerant plants, and silty clay soils, with both Monteola and Victoria clay soils (Carr 2003). Associated plants at this site include mesquite, prickly pear cactus, tasajillo, and numerous forbs and grasses, although the area is mainly covered by herbaceous rather than woody vegetation (Carr 2003). In the past, the land on which the Refugio County population is located was leased for grazing and petroleum activities (USFWS 1987), including a pipeline that was installed through the center of the population. Grazing continued at that site for some years and maintenance of the pipeline right-of-way is ongoing.

Habitat conditions at the Refugio and Kleberg County sites have changed with an overall increase in vegetative cover seen at both sites. Brush clearing for cultivation, planting for improved pasture land (Texas Department of Agriculture 1996), overgrowth of non-native grasses (D. Price, pers. comm. 2006), and cattle grazing have altered the vegetative cover of the natural habitat of BLC. An increase in vegetative cover, as documented at the Kleberg County site, has dramatically increased the competition pressures on BLC for light sources due to the fast-growing and taller aspect of invasive, non-native grasses (D. Price, pers. comm. 2006). This alteration of habitat by invasive grasses was noted as a threat in the recovery plan and because little was known about the BLC's response to this type of threat, the recovery plan recommended close monitoring of the populations (USFWS 1987).

In general, across the range of the BLC, formerly dominant coastal prairie habitats are fragmented and scattered across the landscape. Although some areas are in native range, large sections have been converted to row-crop agriculture and/or planted to pasture using non-native, invasive grasses. According to a 1982 census, 91% of the land in Refugio County was farmed and ranched, with 18% of this agricultural land in cultivation (Handbook of Texas Online [HTO] 2008) and 1 % of the rangeland planted to improved pasture grasses (Guckian 1988). In 1982, San Patricio County was about 93% farmland and/or ranches, with 68% of the agricultural income from crops (HTO 2008). Caliche found in the western part of the county was mined and other natural resources including sand, natural gas, and petroleum were actively extracted (HTO 2008). The 1960 Nueces County soil survey described this county as having 73% of the land in row crop and 13% in range (Franki et al. 1960). Currently, between 61% and 70% of Nueces County is farmland (HTO 2008). In the early 1990's, 85% of Jim Wells County was in ranch and row crop and this county was also a leading oil producer in Texas (HTO 2008). At the start of the 20th century, the ranch-based economy of Kleberg County began a shift to farming and dairy and the row-crop trend strengthened in the late 1950s, continuing to increase in acreage plowed into the present (HTO 2008). Oil and natural gas exploration and production occurs in all

five counties. Continued plantings of non-native grasses, residential development, and row cropping will likely continue to shrink the remaining habitat for BLC in Refugio, San Patricio, and Nueces Counties (TPWD 1996).

2.3.2 Five-Factor Analysis

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

Historically, the greatest threat to BLC was conversion of its native habitat to improved pasture or cropland (USFWS 1987). The final rule to list the BLC as endangered described habitat destruction, due to brush control and range improvement programs, as an immediate and serious threat to the species continued existence. Land cover changes via mechanical means, bulldozing and brush clearing, were documented as causing the loss of at least a portion of the population in Jim Wells County, as well as the original population site in Kleberg County. Elimination of native brush using herbicides was cited as having the potential to kill individual BLC plants (TPWD 1996); however, the extent of this type of loss/damage remains unknown. Active ingredients within Gramoxone, Grazon P+D, Oust, Spike 20P, Remedy, Garlon, and other pesticide products have been identified as being potentially harmful to some plants, including BLC; however, research has not been conducted to determine lethal exposures (Texas Department of Agriculture 1996).

More recently, the status of BLC appears threatened by an overall lack of active management to control non-native, invasive plant species at population sites (D. Price, pers. comm. 2007). Threats to the integrity of remaining habitat of the BLC continue to increase as non-native pasture grasses, including Kleberg bluestem (*Dichanthium annulatum*), King Ranch bluestem (*Bothriochloa ischaemum*), Coastal Bermuda grass (*Cynodon dactylon*), Guineagrass (*Panicum maximum*), Buffelgrass (*Pennisetum ciliaris*), and Carpetgrass (*Axonopus affinis*), have continued to spread throughout the Texas Coastal Bend region, as well as other parts of south Texas. These grasses are opportunistic species, either producing copious amounts of seed that can be spread both deliberately and/or inadvertently, or spreading rapidly by vegetative means. Available soil nutrients are also diminished due to these exotic plant species and growth and spread of the invasive plants is often facilitated or increased by practices such as mowing that disturb soils and alters native plant communities (Kuvlesky et al. 2002). The BLC Recovery Plan's recommendation to concentrate grazing pressure on invasive grasses by strategic placement of fences may help to remove or lighten competitive effects of non-native grasses on the BLC, but studies are lacking and outcomes of this type of management are unknown. There is potential for

this type of management practice to negatively impact mammal species, including those that may aid in seed dispersal of BLC.

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

The final rule to list BLC as endangered described cactus dealers and amateur growers as removing entire plants, as opposed to plant materials, from the wild (44 FR 61918). Plants were reportedly taken from populations in all three counties and over-collection was cited as one cause of localized extirpation (USFWS 1979). Many cacti of the genus *Echinocereus*, including the BLC, are collected by individuals for personal use or trade. The demand for rare cacti by collectors has escalated in the United States, and in other countries, including Japan and Germany (Westlund 1991). The demand for export of BLC to these countries is primarily attributed to the attractive blooms of the species (Westlund 1991).

In 1987, during the course of collecting field data for preparation of the recovery plan, Gardner and O'Brien found no evidence of collecting pressure on any of the three extant populations (USFWS 1987). In 1991, the TPWD published a report on the cacti trade, monitoring impacts by investigating 72 individual collectors, family nurseries, and commercial nurseries (Westlund 1991). Although many of these collectors/growers had less than 50 individual cacti plants representing only three to four species, one collector had more than 1,000 freshly dug cacti of 13 subspecies. Among the three subspecies most heavily collected was the *E. reichenbachii* var. *fitchii*. Due to taxonomic confusion, it is unclear how many of these may have actually been BLC. The report concluded that the already established monitoring of the trade of these flowering cacti needs to be increased. Another finding was that other species in the genus *Echinocereus* have been exploited by smaller dealers, as well as commercial nurseries, without permits (Westlund 1991). Information on the level of threat due to field collecting of this species since TPWD's 1991 report is lacking. Sporadic site visits to the Refugio and Kleberg populations over the last 10 to 15 years have not produced reports indicating that illegal collection is ongoing at either site.

2.3.2.3 Disease and predation:

Disease and predation were not considered factors adversely impacting the BLC when the species was listed in 1979. In 1988, the CCBG found larvae, described as being one-centimeter in length with brown-black heads, in three crown cuttings of BLC from the Kleberg County site. These larvae had bored into the cactus crown and the tissue surrounding the larval bore was necrotic. The CCBG staff removed the larvae, allowing

them to pupate, and a small, unidentified moth was produced. The affected crowns apparently recovered because they were subsequently rooted, flowered, set seed, and produced seedlings. In 1989, the CCBG found insects, later identified as *Chelinidea vittiger* (Uhler), on the 61 BLC seedlings that they collected at the Refugio County population site (Bush 1990). These insects, members of the Family Coreidae, are commonly found on prickly pear and other plants and are known to feed on *Opuntia* sp. Threats from fungal and bacterial diseases known to affect succulent plants may also exist for the BLC, but data is lacking to support this because so few BLC populations are known, access to them is limited, and monitoring is infrequent.

Individual BLC plants have been uprooted by feral hogs and kicked over by cattle (D. Price, pers. comm. 2004). However, no other severe disturbances caused by these mammals or other animals have been noted (D. Price, pers. comm. 2004) with the exception of the presence of red imported fire ants (RIFA). Some BLC individuals at the Refugio County site have been noted to be partially or entirely covered by mounds of RIFA (D. Price, pers. comm. 2004). Although native ants have been observed eating the BLC fruits, Mike Quinn, TPWD invertebrate specialist, postulated that these ants may aid in the dispersal of the species' seed (D. Price, pers. comm. 2004). However, in the case of the RIFA mounds that engulf the BLC, there is potential that these non-native ants could pose threats to the base or quite possibly the root system of the cacti. Also, RIFA may out-compete native ant species and potentially interfere with the role these natives play in seed dispersal (D. Price, pers. comm. 2004). Chemical eradication techniques used for the RIFA might also negatively affect natural pollinators of the species and/or native ants and could potentially contribute to an overall decrease in any treated BLC population (D. Price, pers. comm. 2004). Research on effects of RIFA on BLC, as well as the impacts of pesticides that might be used to eliminate RIFA on pollinators, seed dispersers and the BLC itself, are prerequisites prior to the start of any eradication process.

The level of threat to the continued existence of BLC due to feral hog rooting and cattle trampling is unknown, although observations at the Refugio County population site indicate that this type of impact occurs in a scattered manner. Data showing the short or long-term consequences of the RIFA infestation on the BLC population in Refugio County is lacking and this phenomenon has not been reported from the Kleberg County site. Other than the potential problem associated with RIFA's, only Bush's (1990) report provides any information about insects described from the BLC and no subsequent reports of disease conditions that might be related to insect damage have been forthcoming.

2.3.2.4 Inadequacy of existing regulatory mechanisms:

Black lace cactus was listed as endangered without critical habitat in October 1979 (44 FR 61918). Section 9(a)(2)(B) of the Endangered Species Act (Act) prohibits removal and possession of endangered plants from areas under Federal jurisdiction, however we are unaware of any BLC populations on Federal land. All native cacti, including BLC, are on Appendix II of CITES. This Convention only regulates imports and exports, and does not regulate internal trade or habitat destruction. This agreement was designed to ensure that international trade does not affect the species survival (USFWS 2000) and should afford protection to BLC from collection pressure for exportation purposes.

Under Chapter 88 of the Texas Parks and Wildlife Code, any Texas plant that is placed on the Federal list as endangered is also required to be listed by the State. Therefore, BLC was afforded endangered status by TPWD in 1983. In addition to the State of Texas regulations pertaining to listing, other State laws may apply. The State prohibits taking and/or possession of listed plants for commercial sale, or sale of all or any part of an endangered, threatened, or protected plant from public land. Scientific permits are required for purposes of collection of endangered plants or plant parts from public lands for scientific or education purposes. Commercial permits must be obtained from TPWD to collect endangered plants from private land only if the collector intends to sell the plants or plant material. The destruction or removal of any plant from State lands without a permit from TPWD is unlawful; however, no BLC populations are currently known from State lands. Some states do require inspection of cacti at their ports of entry to identify individuals not licensed for cacti collection.

All known BLC populations occur on private land. The Act, as amended, does not require that private landowners take any measures to protect listed plant species on their lands unless they are receiving Federal funding, being issued a Federal permit, or a federally sponsored project is taking place on their land. According to the Act, listed plants may be removed from private lands at any time unless prohibited by State law. Currently, there are no conservation agreements, binding or voluntary, with any of the BLC landowners. The Refugio County population site landowner has expressed enthusiasm for the conservation of the BLC and is amenable to granting permission for access to the population for research and conservation purposes (Carr 2003, Berger 2006). A Grazing Lands Conservation Initiative (GLCI) Safe Harbor Agreement (SHA) targeting Attwater's prairie chicken (*Tympanuchus cupido attwateri*), northern aplomado falcon (*Falco femoralis septentrionalis*), and the whooping crane (*Grus americana*) was approved in 2007, and included the BLC. This SHA is designed for the Service, the Coastal Prairie

Coalition, and the GLCI to restore, reclaim, conserve, and manage habitat used by these species (USFWS 2007). Proposed actions in the SHA that support BLC recovery plan tasks include providing habitat protection through landowner cooperation and ensuring that grazing pressure does not threaten BLC populations (USFWS 2007).

Because all known occurrences of BLC are on privately-owned land, existing regulations do little to protect the species except for increasing landowner's ability to litigate against trespassing collectors. Only one landowner has signed any type of conservation document, the SHA, and the type of long-term conservation agreements/easements recommended in the recovery plan have not been secured. The species' federally-listed endangered status does help to enhance the likelihood of funding to carry out needed research and other recovery activities on private land if the landowner is amenable.

2.3.2.5 Other natural or manmade factors affecting its continued existence:

The final rule to list the BLC as endangered referred to the species being restricted to a specialized and localized ecotonal plant community with a low population level that consisted of small, scattered, and disjunct populations, thus producing a restricted gene pool. These factors were considered as tending to intensify adverse effects of damage to the plants or their habitat. Black lace cactus is known from only a few populations, some with very few individuals; therefore, the gene pool is believed to be extremely limited. Small populations are inherently vulnerable to catastrophic events like tropical storms or prolonged droughts, and/or deterministic genetic and demographic issues such as inbreeding, genetic drift, loss of genetic variability, and random variations.

Fire, whether prescribed or natural, can cause mortality of *Echinocereus reichenbachii* species. Mortality of cacti, including *Echinocereus reichenbachii*, has been associated with both fire and animal use (Humphrey 1958). A three-year study on the Dalby Ranch in Garza County, Texas, investigated the response to fire of cacti species including *Echinocactus texensis*, *Mammillaria gummilera*, *Coryphantha vivipara*, *Echinocereus reichenbachii*, and *Opuntia engelmannii* located in areas dominated by tobosagrass (*Hilaria mutica*), alkali sacaton (*Sporobolus airoides*), walkingstick cholla (*Opuntia imbricata*), and honey mesquite (*Prosopis glandulosa*) (Bunting et al. 1980). These researchers marked 18 individual cactus plants prior to the prescribed burn and subsequently monitored the mortality rates of the cacti for three years after the initial prescribed burns. Results showed 17%, 89%, and 94% mortality after one, two, and three years, respectively. These researchers found that other factors (e.g., interactions with insects, rodents, or disease), acting in

concert with the fire, caused the mortality increase over this time period (Bunting et al. 1980). Although wildfires were common occurrences across the Texas coastal plain before humans attempted to suppress them, the effects of fire on BLC, whether prescribed burns or fires caused by natural events, within its specific habitats has not been investigated.

The drift of broad-spectrum insecticides used for the maintenance of cotton plants, a common crop in Texas Coastal Bend counties, may appear in the habitat of BLC and cause mortality of many insect pollinators and seed dispersers, such as bees and ants (USDA 1996). Therefore, potential exists for indirect effects to BLC from pesticide use if these chemicals adversely impact BLC pollinators. Because the three counties where BLC occurs are included as Texas Boll Weevil Control counties, the U.S. Department of Agriculture's Animal and Plant Health Inspection Service (APHIS) proposed two sets of protection measures with a goal of avoiding adverse impacts to BLC's pollinators and native ants (USDA 1996). The Texas Department of Agriculture (TDA) also developed a flyer entitled "Texas Stewardship: Conserving Native Species" that provided recommendations for voluntary practices to avoid impacts to listed species, including the BLC, when applying pesticides.

Trampling by livestock can also cause problems for individual BLC plants in habitats where grazing occurs, as noted in the recovery plan (USFWS 1987). In the Jim Wells County population, BLC growing in open ground were trampled and few plants survived to maturity, whereas surviving cacti were protected by other vegetation (USFWS 1987).

Also, climate change could affect BLC. According to the Intergovernmental Panel on Climate Change (IPCC) (2007, p. 1) "Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level." Average Northern Hemisphere temperatures during the second half of the 20th century were very likely higher than during any other 50-year period in the last 500 years and likely the highest in at least the past 1300 years (IPCC 2007, p. 1). It is very likely that over the past 50 years: cold days, cold nights and frosts have become less frequent over most land areas, and hot days and hot nights have become more frequent (IPCC 2007, p. 1). It is likely that: heat waves have become more frequent over most land areas, and the frequency of heavy precipitation events has increased over most areas (IPCC 2007, p. 1). To date, these changes do not appear to have had a negative impact on the BLC.

The IPCC (2007, p. 6) predicts that changes in the global climate system during the 21st century are very likely be larger than those observed during the 20th century. For the next two decades a warming of about

0.2°C (0.4°F) per decade is projected (IPCC 2007, p. 6). Afterwards, temperature projections increasingly depend on specific emission scenarios (IPCC 2007, p. 6). Various emissions scenarios suggest that by the end of the 21st century, average global temperatures are expected to increase 0.6°C to 4.0°C (1.1°F to 7.2°F) with the greatest warming expected over land (IPCC 2007, p. 6-8). Localized projections suggest the southwest may experience the greatest temperature increase of any area in the lower 48 States (IPCC 2007, p. 8). The IPCC says it is very likely hot extremes, heat waves, and heavy precipitation will increase in frequency (IPCC 2007, p. 8). There is also high confidence that many semi-arid areas like the western United States will suffer a decrease in water resources due to climate change (IPCC 2007, p. 8). Milly et al. (2005) project a 10–30 percent decrease in precipitation in mid-latitude western North America by the year 2050 based on an ensemble of 12 climate models.

Climate change can cause or exacerbate direct stress to vegetation communities and individual plant species through high temperatures, decreased water availability, altered frequency of extreme weather events and severe storms. Less frequent freezes can enhance grass growth, thereby facilitating invasion of BLC sites by several species of non-native grasses currently proliferating throughout southern Texas (see Section 2.3.2.1). Encroachment by woody plants and non-native grasses has been noted at the Kleberg County BLC population site where the lack of active management was cited as a potentially threatening situation for the continued existence of that population (see Section 2.3.2.1).

Invasion of an ecosystem by non-native plants can change fuel properties, thereby affecting fire regime characteristics including frequency, intensity, extent, type, and seasonality of fires (Brooks et al. 2004). If the changed fire regime favors the invasive species, these invaders can become the dominant species within the plant community and a new fire cycle can become established. Because all ecosystem components and the interactions between these components are affected by the changed fire scenario, restoration back to pre-invasion conditions becomes more difficult (Brooks et al. 2004). As noted in Section 2.3.2.5, the effect of fire on BLC plants is not known. There is potential for fire to play a larger role in the ecosystem in which BLC occurs if the population sites become increasing invaded by non-native grasses.

Temperature increases have also been documented to increase invasion by pest insect species as these insects undergo range expansions allowed by diminished frequency of freezes and the northward shift of the frost line. This is illustrated by the continually-expanding range of the red imported fire ant (RIFA). In the case of the BLC, RIFA are listed as a potential threat at the Refugio County population site due to their mound-building

activities around individual BLC plants, although the effects of this activity on the cacti are unknown (see Section 2.3.2.3).

Because global warming has been shown to expand the range of some insects, as well as dates of their migration, there is potential for BLC reproduction to be affected by changes in pollinators' ranges and seasonality. To date, BLC pollinators have not been identified, therefore we cannot address potential for adverse impacts to pollination in the subspecies.

Heavy, albeit infrequent, precipitation events resulting from climate change could potentially enhance sheet flow-driven soil erosion at BLC sites because the species grows in more open aspects of the brush and grassland interface. Extremely heavy rainfall occurring in conjunction with high storm tides could potentially cause over-bank flooding into the Refugio and Kleberg County populations, producing short-term inundation of the populations with fresh-to-brackish water. The effect of short-term flooding on the cactus is unknown. Heavy precipitation associated with extreme storm events, both tropical and northwestern in origin, could also potentially affect the BLC by leaching salt from the underlying soils and creating soil moisture and salinity conditions that may favor invasive species over the slower-growing cactus. However, this scenario is purely conjecture because the descriptions of saline soils underlying the existing populations are based on observations of vegetation community composition and not on soils analysis.

Accelerated sea level rise along the entire Texas coast is also projected to be a consequence of climate change, but is not anticipated to directly impact the BLC population sites. Although the BLC is found within the Coastal Prairies and Marshes Ecoregion of Texas, the geographic location of the three populations is upstream of the most western edge of secondary (as opposed to primary) bays, and the distance inland from the bay margins and the elevations at all three population sites should preclude flooding by marine waters due to storm surges. The Refugio County and Kleberg County populations occur nearby tributaries to, and within eight miles and three miles of Copano and Baffin Bays, respectively, but both populations grow above the 25 feet elevation lines. The population site in Jim Wells County is adjacent to San Fernando Creek, an ephemeral tributary to the Baffin Bay system, but this population is approximately 25 miles inland at elevations between 130 to 150 feet above mean sea level.

So far, global climate models do not have the precision to predict the duration, frequency, or seasonality of droughts and there are no detailed studies on the potential effects of climate change on the distribution of native species of plants and animals in Texas. Statewide predictions about changes in biodiversity are not possible due to uncertainties regarding

changes in land use, water use, human populations, seasonal rainfall, rate of climate change, and climatic variability (Packard et al. 2009). Endemic and rare species, such as the BLC, tend to be the most vulnerable to the suite of alterations associated with changing climate because they are adapted to more specialized, narrow sets of conditions (microclimates) that may disappear with a warming climate. Therefore, these rare endemics are more likely to be adversely affected than species with a wider tolerance of climatic conditions. Those species that cannot move between suitable habitat fragments are also highly vulnerable (Packard et al. 2009). In the case of the BLC, we lack data about microclimates required by the species. We do know that the three documented populations are widely separated geographically, and that for the most part, the habitat lying between the three is remnant, having been fragmented by agricultural and residential land uses, thereby enhancing the BLC's vulnerability. However, there is potential for more undiscovered populations to exist within the BLC's range, so the degree of vulnerability due to isolation is not clearly understood.

While it appears reasonable to assume that the BLC may be affected by all the changes anticipated to result from global warming, we lack sufficient certainty to know exactly how climate change will affect this endangered subspecies. To date, changes to the status of the black lace cactus that can be directly correlated to increased temperatures or changes in precipitation amounts or frequencies have not been documented.

2.4 Synthesis

The recovery plan for BLC was finalized in 1987 and did not contain objective, measurable criteria for delisting, but instead indicated the need for permanent protection of the known populations to move the species to threatened status. This level of protection has not been obtained and all documented populations are still on privately owned land with no conservation agreements or management plans in place for the species.

The recovery plan did reflect the need for research that would help in determining and quantifying habitat and abundance requirements so that objective, quantifiable delisting criteria could be developed (USFWS 1987). Very little biological or ecological information was available for the BLC when the recovery plan was approved in 1987, and subsequent to that date, the only biological data that has been gathered involves seeds, germination, and cultivation techniques. The known populations of BLC have not been surveyed on a consistent, repeated basis. Thus, status and trends in abundance are not clear, although the plants in the Refugio and Kleberg County populations appear to have declined in number. Distribution information is limited to the populations known at the time of listing, over 20 years ago, and survey efforts for new populations have not been systematic or extensive

throughout the species' range. The Jim Wells County population has not been revisited since 1989, so its current status is unknown. The overall lack of data has resulted in a depauperate knowledge base for State and Federal resource agencies to draw on and to communicate to landowners. Management needs of the species and suggestions for dealing with threats constitute important information gaps that need to be filled prior to developing management recommendations to share with landowners. Development of conservation efforts, including consistent landowner contact, is of utmost importance to the species because all extant individuals of BLC occur on private lands.

Historically, conversion of native landscapes within the BLC range to monoculture pastures for grazing or other types of agricultural uses caused loss of the species' habitat and directly destroyed some subpopulations. In more recent years, the BLC appears to have suffered from a lack of active management at population sites, and as a consequence, these areas are being overtaken by non-native, invasive grasses, or are changing in character due to encroachment by woody species. Non-native grasses in this region are aggressive colonizers, prolific seed producers, and potentially out-compete the BLC for light and space in its natural environment (D. Price, pers. comm. 2006). Studies aimed at removing non-native grasses and investigation into the species' pollinators and seed dispersal mechanisms are needed. Herbicide use or fire has the potential to damage the BLC but there is no direct evidence of adverse impacts from either factor at the known population sites.

The degree of threats from other factors, including mound-building activities of RIFA's, or the level of damage from feral hog rooting, is not well understood because biological and ecological research has not been undertaken for the BLC. Although two species of insects have been documented as occurring on BLC with the potential to do some damage to individual plants, the threat level associated with these insects has not been evaluated. Because BLC's pollinators are unknown, levels of indirect threat to its reproduction from various pesticide application programs, like the APHIS boll weevil control program, or drift from pesticide applications to cotton crops, have not been ascertained. Although TPWD did find 15 BLC specimens available for sale in the Texas cactus trade, it was never determined that any of these specimens were removed from wild populations. The level of illegal collection of BLC from wild populations is undocumented and it is therefore unknown whether illegal harvest constitutes any level of threat to the species' continued existence.

The BLC Recovery Plan calls for maintenance of specimens in botanical gardens/herbaria to provide an "important source of material for non-destructive research, maintenance of wild populations, and public awareness," but at this time, the species is not being maintained at a refugia population (USFWS 1987). Seeds, collected from the Refugio County population, are stored at the DBG; however, the BLC is not currently being cultivated there.

Experimental planting of BLC into Duval County in 1990 was a step toward natural reintroduction of the species into habitats that may be able to sustain a species needing saline/clayey soils, but long term survival was not attained (TNDD 2007).

We recommend that BLC remain endangered due to its risk of extinction throughout portions or all of its range. Our best available information indicates that the species appears to be declining based on counts from the Refugio and Kleberg County populations. The Jim Wells County population has not been visited in 19 years, therefore its status is completely unknown, but parts of that population had already been lost by the time the recovery plan was developed in 1987. The primary threats to the species at the time of listing in 1979 were habitat destruction and over-collection. Since that time, additional habitat has been lost to brush clearing, pipeline construction, and to invasion by non-native grasses and overgrowth with woody plant species. The level of threat from trampling by livestock, uprooting by feral hogs, and mound building by RIFA's has yet to be determined. All three populations lack the permanent protection of conservation easements that were recommended in the recovery plan as the sole recovery criterion for downlisting. No delisting criteria were ever established for BLC. In addition to apparent declines in the number of cacti within the Kleberg County population, conditions at the site as recently as 2006 were noted as suffering from a lack of active management which had produced conditions of overgrowth by aggressive, non-native invasive grasses as well as increases in woody plant cover. Regular, systematic monitoring of this species has not been undertaken, so causes for the BLC's declines at both the Refugio and Kleberg County sites are not well documented. More systematic, regular survey work and landowner contact might provide more significant evidence of declines in the populations; however, the current population abundance, the levels of threat, and the minimal level of management that has been implemented, indicate that the BLC meets the definition of endangered.

3.0 RESULTS

3.1 Recommended Classification:

- Downlist to Threatened**
- Uplist to Endangered**
- Delist**
- No change is needed**

3.2 New Recovery Priority Number: No change; recovery priority number remains at 3.

4.0 RECOMMENDATIONS FOR FUTURE ACTIONS

Thorough, systematic searches for new BLC populations are needed throughout the species' range. Potential habitat should be identified and surveyed, once landowner permission has been granted. Although saline soils underlie all three BLC sites, more in-depth soils investigation at the known populations may help to further characterize specific soils and geologic properties that would aid in identifying areas in which to concentrate future population searches. In light of taxonomic controversy regarding the *E. reichenbachii-fitchii* complex, a thorough systematic review, including genetic studies of the species complex, should be conducted.

Collaborative studies should be done to investigate life history requirements, including reproductive biology, and propagation techniques. Experimental studies need to address current and potential threats including impacts of insecticide on cacti pollinators and native seed dispersers such as ants and direct threats to BLC from non-native red imported fire ants, as well as from native insects. Feral hog activity levels within BLC populations should be monitored to ascertain the level of damage that occurs from uprooting of, and potentially from foraging on, BLC caused by these animals. In addition, the role of fire in the management of the species should be examined.

All known populations of BLC exist on private lands. The Service and TPWD should pursue development of conservation plans with current landowners, along with investigating potential for permanent conservation easements. The assessment of appropriate conservation/management measures should be collaborative between landowners, resource agencies, and researchers. Evaluation of the species' status, degree of threats, and level of protection at known population sites is needed on a more frequent and regular basis. Landowners should be informed of new management strategies.

Public education should be implemented to educate others about this endangered species and to protect the species from becoming a target of illegal take and distribution. Information about the regulations governing take and propagation of wild and nursery species for trade should be distributed to appropriate partners. Refugia specimens should be grown and maintained to further aid in propagation studies and to enhance the ability of nurseries, botanical gardens, and the general public to identify the species, if encountered.

The recovery plan for the species needs to be revised to incorporate all new information on biology, ecology, and management recommendations. Objective and measurable recovery criteria for down- and delisting of the species should be developed which also address all listing factors relevant to the species.

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**U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW**

Black Lace Cactus (*Echinocereus reichenbachii* var. *albertii*)

Current Classification: Endangered

Recommendation resulting from the 5-Year Review:

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

Appropriate Listing/Reclassification Priority Number, if applicable: n/a

Review Conducted By: Robyn Cobb, Corpus Christi Ecological Services Office, Texas

FIELD OFFICE APPROVAL:

Lead Field Supervisor, Fish and Wildlife Service

Approve Alan M. Stone Date 1-30-09

REGIONAL OFFICE APPROVAL:

Assistant Regional Director, Ecological Services, Fish and Wildlife Service, Region 2

Signature Nancy J. Goman Date 3/26/09