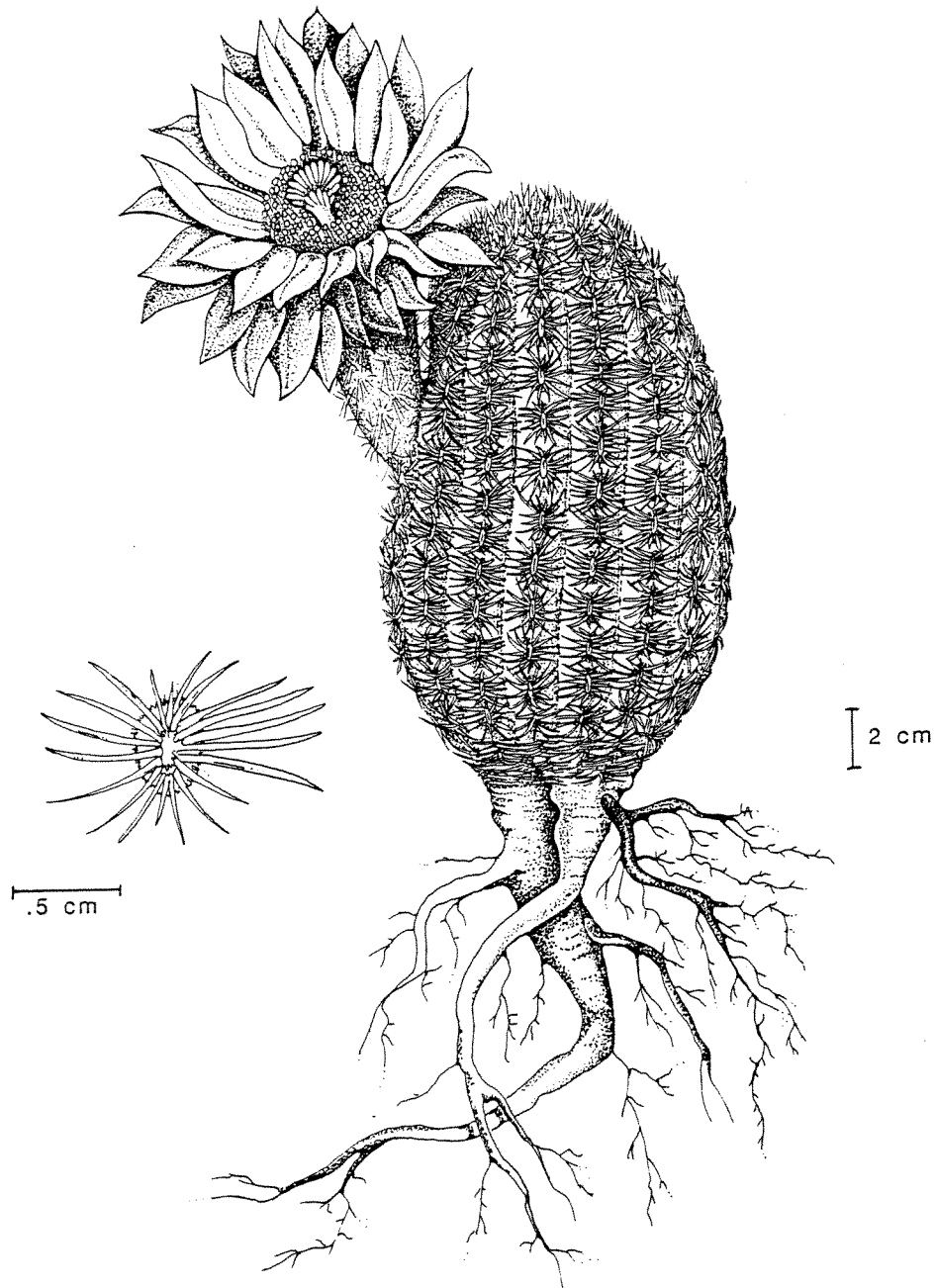


BLACK LACE CACTUS

(*Echinocereus reichenbachii* var. *albertii*)

RECOVERY PLAN



U.S. Fish and Wildlife Service
Albuquerque, New Mexico

1987

BLACK LACE CACTUS

(Echinocereus reichenbachii var. albertii)

RECOVERY PLAN

Prepared by:

Dr. Sue Gardner

and

Ruth O'Brien

Corpus Christi Botanical Society, Inc.

for

Region 2

U.S. Fish and Wildlife Service
Albuquerque, New Mexico

Reviewed and edited by:
Charles McDonald

APPROVED: Michael Green
Regional Director, Region 2

DATE: 3/18/87

DISCLAIMER

This is the completed Black Lace Cactus Recovery Plan. It has been approved by the U.S. Fish and Wildlife Service. It does not necessarily represent official positions or approvals of cooperating agencies and does not necessarily represent the views of all individuals who played a role in preparing this plan. This plan is subject to modification as dictated by new findings, changes in species status, and completion of tasks described in the plan. Goals and objectives will be attained and funds expended contingent upon appropriations, priorities, and other constraints.

Literature citation should read as follows:

U.S. Fish and Wildlife Service. 1986. Black Lace Cactus (Echinocereus reichenbachii var. albertii) Recovery Plan. U.S. Fish and Wildlife Service, Albuquerque, New Mexico. 51 pp.

Additional copies may be purchased from:

Fish and Wildlife Reference Service
6011 Executive Blvd.
Rockville, Maryland 20852
Phone: (301) 770-3000
Toll Free - 1-800-582-3421

ACKNOWLEDGEMENTS

Information and assistance in locating the three populations of black lace cactus were provided by Fred B. Jones, Richard O. Albert, and Gene Blacklock. Without their assistance, this study would not have been possible. We would also like to thank Mr. Jones and Bryan Chapman for reading this manuscript.

Assistance in preparation of this plan was provided by Texas Plant Recovery Team members: Mr. Harold Beaty, Dr. William Mahler, Mr. David Riskind, Mr. Gerald Hoddenbach, Dr. Richard Worthington, Ms. Jackie Poole, Dr. Allan Zimmerman, and Dr. Elray Nixon.

SUMMARY

- Goal:** To remove the black lace cactus from the Federal list of endangered and threatened species by managing the essential habitat in a way that will assure the continued existence of natural self-sustaining populations.
- Recovery Criteria:** The criteria for downlisting the black lace cactus to threatened will be to establish permanent protection for two or more of the known populations at present populations levels. Precise delisting criteria will be established after the success of management at permanently protected populations can be evaluated and a search for additional populations can be carried out.
- Actions Needed:** The major steps needed to meet the recovery criteria include: enforcing existing Federal and State endangered species laws, obtaining management rights and long term protection for essential habitat, developing and implementing habitat management plans, searching for unknown populations, initiating population biology and ecology studies, locating potential habitat for establishing new populations, establishing populations at botanical gardens, and developing public support for preservation of the black lace cactus.

PART I

INTRODUCTION

Brief Overview

Echinocereus reichenbachii var. albertii L. Benson, the black lace cactus, was listed as endangered on October 26, 1979 (44 FR 61918). It is also listed as endangered by the State of Texas. Of the five other varieties of Echinocereus reichenbachii (Benson, 1970), two, E. reichenbachii var. chisoensis and E. reichenbachii var. fitchii, are under review for possible listing (50 FR 39526, September 27, 1985). Six other species or varieties of Echinocereus are listed as endangered: E. engelmannii var. purpureus (44 FR 58868), E. fendleri var. kuenzleri (44 FR 61927), E. lloydii (44 FR 61916), E. triglochidiatus var. arizonicus (44 FR 61558), E. triglochidiatus var. inermis (44 FR 64746), and E. viridiflorus var. davisii (44 FR 64740).

Echinocereus reichenbachii, the lace cactus, is well known and widely collected. It has a range extending from western Kansas to northern Mexico (Bakeberg, 1977; Britton & Rose, 1963). According to Britton and Rose, Echinocereus reichenbachii occurs among rocks in limestone country. The variety albertii is an exception to this occurring in sandy-loam brush tracts in three

counties of the Texas Gulf Coast (Figure 1): east central Jim Wells County, northern Kleberg County, and southern Refugio County (Jones, 1982).

Echinocereus reichenbachii var. albertii is presently known from only three extant populations, all on private land. Brush clearing to improve pastures and create cropland has resulted in the loss of considerable habitat for the species. One population and a large part of the presently extant population in Kleberg County were destroyed by brush clearing (Fred B. Jones, Corpus Christi, Texas, 1986 pers. comm.). The original stand of the Jim Wells County population was all but destroyed by brush clearing, with probably no more than two dozen plants remaining. An all weather road longitudinally transects the Refugio County population. Habitat destruction, along with collecting, threatens the survival of this small and attractive cactus.

The objective of this recovery plan is to outline a means for facilitating the recovery of Echinocereus reichenbachii var. albertii by managing the existing populations and protecting them from the threats of collecting and habitat destruction. In addition, by establishing new populations in protected sites such as botanical gardens and/or wildlife refuges, this variety can be protected from extinction.

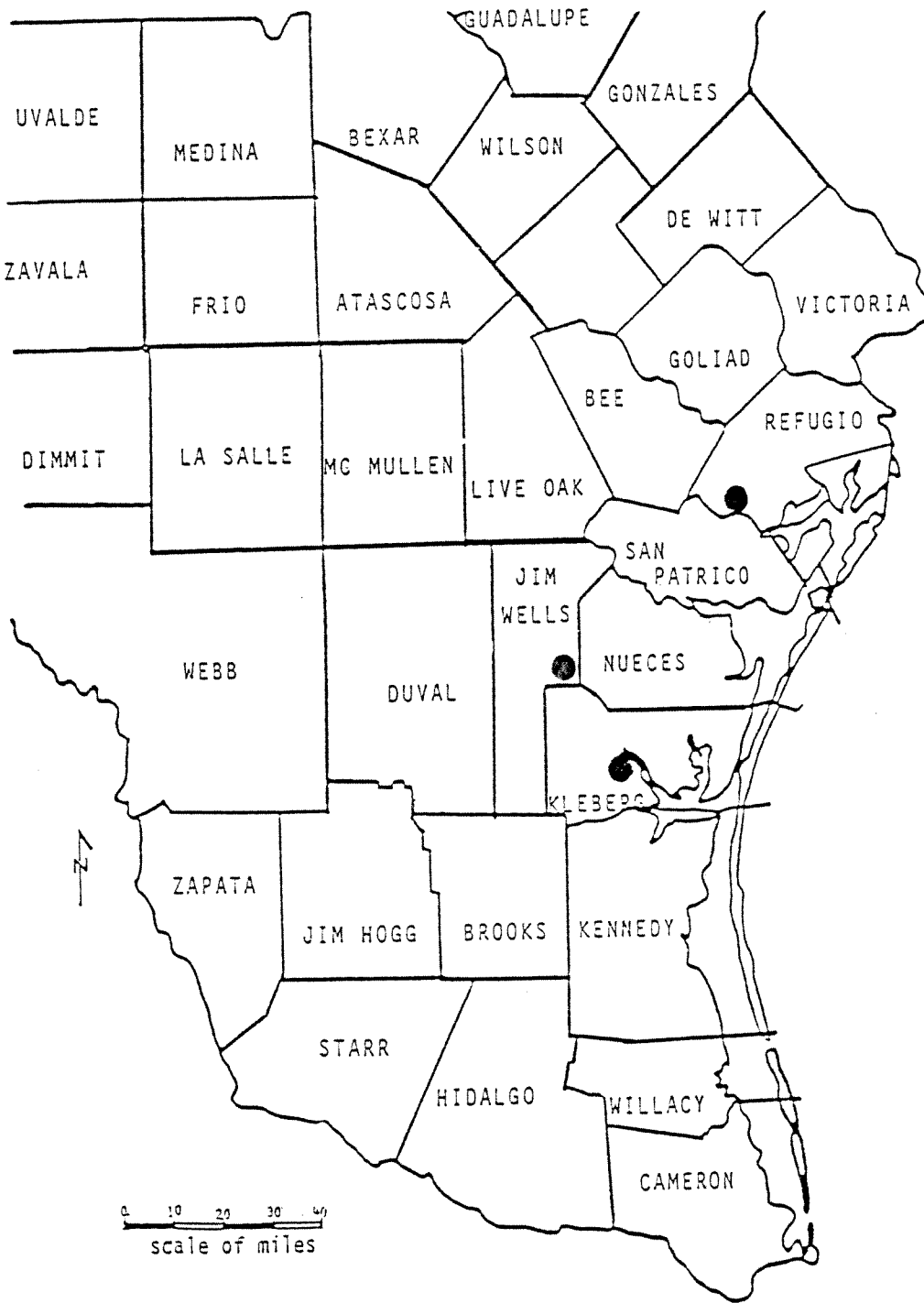


Figure 1. Approximate distribution of *Echinocereus reichenbachii* var. *albertii* in south Texas.

This plan begins with background information on the black lace cactus, including considerations of distribution and abundance, taxonomic relationships, habitat requirements, conservation and research efforts, and threats to the populations. A detailed outline of actions necessary to recover E. reichenbachii var., albertii follows in the format of a step-down outline. The narrative section of the outline provides more information on actions necessary to counteract threats to the black lace cactus. The final section of this plan contains an implementation schedule that lists the recovery tasks, their priorities, agencies involved, and estimated costs.

Taxonomy and Morphology

Echinocereus reichenbachii var. albertii L. Benson, Cact. and Suc. J. (U.S.) 41:127, 1969 from a specimen collected May 25, 1965 in Jim Wells County near Alice, Texas. TYPE: Richard O. Albert and Lyman Benson 16,550, POM 317,080. Other specimens: F.B. Jones 2965, C.C. Museum (2 sheets) and Welder Foundation (1 sheet), April 7, 1959, Kleberg Co., about 4 mi southeast of Ricardo on loamy slope near creek, shaded lightly by mesquite and other brush, flowered in cultivation; F.B. Jones 8043, C.C. Museum, April 11, 1974, Refugio Co., about 8 mi east of Bayside in low mesquite brush, sloping tight-sandy loam, flowered in cultivation.

Synonym: Echinocereus melanocentrus Lowry, DESERT

PLANT LIFE, 2:20, 1936. Nomen nudum.

Echinocereus reichenbachii var. albertii: stems solitary or sometimes 5-12, the larger green, cylindroid, 7.5 - 15 cm long, 2.5 - 5 cm diam.; ribs about 12 to 18; areoles narrowly elliptic, 1.5 mm long vertically, typically 2 - 4.5 mm apart; central spines none or 1, 2 - 3 mm long, very dark purple, much smaller than the radials, but otherwise similar to them, straight (we found plants from Kleberg County have well developed central spines, while they are weakly developed or absent in specimens from Jim Wells and Refugio Counties); radial spines white with dark purple tips, 14 - 16 per areole, closely pectinate, 3 - 4 (6) mm long, 0.2 - 0.35 mm diam., circular in cross section; flower 5 - 7.5 cm diam., 2 - 6 cm long; areoles of floral tube with conspicuous fine wool and weak spines; sepaloids with green midribs and pink margins; petaloids pink to light purple, largest oblanceolate, 2.5 - 3.5 cm long, \pm 9 mm broad, short acuminate, entire; filaments pale yellow or pink, \pm 9 mm long; anthers yellow, 1.5 mm long, oblong; style pink, 20 - 30 mm long, 1 - 2 mm greatest diam.; stigmas 16 - 20, green \pm 6 mm long, broad; ovary in anthesis \pm 9 mm long; fruit green (with pink tinge?) with short spines and soft conspicuous, deciduous, long wool in areoles, \pm 15 mm long, 9 mm diam.; seeds strongly tuberculate, asymmetrical, 1.5 mm long, 1 mm broad, 0.7 mm thick (Benson, 1982).

There seems to be some disagreement about the taxonomy of the group of Echinocereus with large pink flowers. Several similar varieties (species?) with only minor differences occur. Weinger (1984) treats plants from the populations in question as Echinocereus melanocentrus with no common name. He uses the common name black lace in reference to Echinocereus caespitosus var. purpureus (Lahman) Weniger which occurs in western Oklahoma, to which he notes E. melanocentrus is similar, but with differing flowers. He also notes that E. melanocentrus has flowers identical to E. fitchii (= E. reichenbachii var. fitchii) which occurs along the Rio Grande from Rio Grande City northwest past Laredo to Eagle Pass, Texas. He describes this species as having 3 - 7 spreading central spines and radial spines not pectinately arranged.

During this study, we noted some morphological variation among the three populations of E. reichenbachii var. albertii, with the Kleberg County population being most distinct. Plants in the Kleberg County population differ from those in the other populations by having a larger stature and well developed central spines.

Current Status of Echinocereus reichenbachii var. albertii

Populations

Jim Wells County. The original population in this county was discovered when a school boy brought in a specimen he had collected near his home. The plant was found in an area that borders San Fernando Creek and it has since been bulldozed and plowed. However, examination of a patch of low, open brush, approximately 10 m X 30 m (33 ft X 98 ft) adjacent to the plowed field revealed at least four surviving groups of 4 to 12 plants each. No black lace cacti were found in the high, dense mesquite brush surrounding this opening.

A second population (from which Benson described the variety in 1969), is approximately a half mile south across the creek, and is probably an extension of the original population. This site, discovered by Richard O. Albert, was undisturbed as of October 1985. This population of black lace cactus occurs over an open area of approximately 1.5 hectares (3.7 acres) within approximately 22 hectares (54 acres) of dense mesquite brush. While most of the individuals of the black lace cactus grow among other low plants or under the sparse canopy of small shrubs, the cacti grow equally well on open ground in full sun. Since cattle graze the area, the cacti in open ground are more vulnerable to trampling than are those protected by other vegetation; plants occurring in the open rarely

survive to maturity. The soil is sandy loam but is poorly drained. The site is level so water stands after heavy rains. Nostoc and mosses occur, and vegetation grows in slightly raised island-like patches separated by bare ground.

Distribution of the black lace cactus, within the site, varies. An area of less than 375 m² (4,035 ft²) is densely populated, with all vegetation "islands" having numerous specimens. Outside of this densely populated area, only a few of the "islands" have black lace cactus. On the southeast perimeter density drops off gradually over about 100 meters (328 ft). On the northwest perimeter, the population remains dense out to the edge, which is about 25 m (82 ft) from the center. A sample area 50 X 25 meters (164 X 82 ft) was marked off and 8 meter-squares, arranged in a grid pattern, were counted. An average of 4.5 plants per square meter (.42 plants per sq ft) was calculated then extrapolated for the entire dense area. Based on an assumption that the sparser part of the population contained 90 percent fewer plants per square meter when compared to the denser area the number of specimens in the entire population was roughly estimated at more than 16,000 including all age categories. This estimate is viewed as conservative. An additional meter-square, selected for density, had 56 specimens of all ages. The presence of numerous seedlings indicates that the population is reproducing well, and if left undisturbed, is not threatened. The property is

privately owned. .pa Some recent brush clearing has occurred nearby, and plans for future range improvements are unknown.

Kleberg County. The locality from which Fred B. Jones made the earliest known collection of black lace cactus is on a high bank along Jaboncillos Creek. This original population was destroyed by brush clearing and the site planted in coastal Bermuda grass. A second population was later found elsewhere along the south side of a broad swale of the same creek by a cactus collector. This site was also cleared of brush and is now under cultivation. However, we found a surviving population of black lace cactus in a broad band of uncleared brush along the slopes of the creek. The population consists of several small but dense stands on both sides of the creek. These stands occur in natural openings with moderate to sparse covering, and not in the dense brush. The black lace cactus occurs in exposed locations, often among patches of grasses and herbs, or under small open shrubs and prickly pear cactus. The soil is sandy loam and the sites occupied by the black lace cactus appear to be in drainage areas for the adjoining fields. Two major stands occupy about 1,500 m² (16,140 ft²) each. In a sample area of 25 X 30 meters, (82 X 164 ft) the number of black lace cacti in 8 meter-squares forming a grid across the sample area were counted. An estimate of 0.25 plants per square meter (.02 plants per sq ft) was calculated from these samples, which, when extrapolated for both stands,

would be less than 750 plants. All but one sample square fell on empty areas, although many dense areas were present. A selected meter-square contained 71 individuals. In our opinion, a very conservative estimate for these two stands would be 3,000 black lace cacti, or one per square meter.

Another dense stand occurs a few hundred meters west, at a bend in the creek. It covers about 2,250 m² (24,210 ft²). Eight meter-squares, taken as above, over a 25 X 50 meter (82 X 164 ft) sample area yielded an average of one plant per meter-square (.09 per sq ft). When extrapolated for the entire stand, the estimate is 2,250 plants which is also thought to be conservative. A selected meter-square contained 47 individuals. This stand occupies a markedly more sloping terrain than the previous ones. Dense clusters in this stand are found under larger, somewhat denser shrubs and trees than were noted in the other stands.

A fourth stand, directly across the creek on the north side, was discovered later by Wilkinson and party in connection with a study of E. reichenbachii for a vegetation resource report on the Choke Canyon Reservoir project. This stand occupies a natural opening in otherwise dense mesquite brush and covers about 1,250 m² (13,450 ft²). Counts of four meter-squares in a grid over a 25 X 25 meter (82 X 82 ft) sample area resulted in an estimate of 6.5 plants per square meter (0.6 plants per sq ft). Extrapolation to the entire stand results in an estimate of about 8,000 black lace cacti.

Old, branched specimens dominate all the stands of the population examined in Kleberg County. While some young plants were noted, they did not make up as large a proportion of the population as was found in the Jim Wells County population.

This population occurs on private property and probably has thus far been saved from site destruction because the plants are on sloped, drainage areas along a creek bed. Some recent brush clearing was noted nearby and plans for further clearing, if any, are unknown.

Refugio County. A large, but patchy population of black lace cactus is scattered over about 17 hectares (42 acres) adjacent to the Aransas River in Refugio County. The cactus is dense over part of the population, and quite sparse in others. Plants occur only in the large open areas of running mesquite and large prickly pear cactus, not in the taller, denser mesquite brush. The cactus occurs among grasses and herbs, or under small shrubs and prickly pear cactus on slightly raised areas of the relatively flat to slightly sloped ground. Nostoc and mosses occur in patches over the site. Eight meter-squares, taken as above, over a sample area of 25 X 50 (82 X 164 ft) meters were counted. An average of 4.25 plants per square meter (.39 plants per sq ft) was calculated. We estimated that the densest area covered approximately 2,500 square meters (26,900 sq ft) and

that the remaining part of the population was 10 percent as dense. Based on these results and assumptions, we calculated about 82,500 plants for this population.

The black lace cacti in this population appear to be narrower and less robust than those at the Jim Wells County or Kleberg County sites. Several dead plants and a smaller proportion of juvenile plants were noticed than in the Jim Wells County population. Many of the mature specimens were highly branched individuals.

The property where this population occurs is privately owned and is leased for cattle grazing and petroleum activities. A service road transects the population and some recent brush clearing has occurred in the area. We have no knowledge of future plans for this tract.

Habitat

Benson (1982) described the open area where the black lace cactus occurs as "disturbed areas of brushland." Wilkinson (1977) described the site he knew as having a dominant overstory of large mesquite and a dense understory of broomweed and spiny aster, while Weniger (1979) reported this cactus occurs "in or under extremely heavy brush thickets..." (p. 4); however, on page

5 he notes "the plant grows well in open, unshaded areas, but also grows commonly in the thin shade produced by these small-leaved brush species." We found that the black lace cactus grows in natural open areas, sparsely covered with very low brush, not resulting from disturbance. Two of the sites were dominated by running mesquite and other low shrubs of a meter or less in height.

The habitat for Echinocereus reichenbachii var. albertii is characterized as openings in mesquite brush occurring along streams of the coastal plain at 50 m (164 ft) or less in elevation. The known sites occur in three south Texas coastal counties Jim Wells, Refugio, and Kleberg. These counties form a semi-circle around two other counties, Nueces and San Patricio. These five counties contain considerable potential habitat for finding or establishing additional populations. The exact edaphic requirements and means of dispersal need to be determined to discover the reasons for absence of the black lace cactus on apparently suitable habitat. At each site, the populations were more limited in area than the apparent potential habitat.

Associated Species

The vegetation where the black lace cactus occurs is characterized by scattered open shrubs, subshrubs, prickly pear

cactus, grasses, and annuals. Running mesquite (Huss, 1959), a growth form that rarely exceeds three feet above ground, with roots and stems oriented parallel to the soil surface, typifies the Jim Wells County and Refugio County sites. A relationship between running mesquite and the presence of gypsum was suggested by Huss (1959), while de la Pena (1969) noted that deficiencies in phosphorous, sulfur, and sodium were found in some running mesquite soils. Soil at each site is sandy loam or silt, and may be level and poorly drained or sloped and well drained. Some of the species associated with the three known populations of black lace cactus suggest a high saline content in the soil, e.g., Monanthochloe littoralis (Gould, 1965), Atriplex klebergorum (Correll & Johnston, 1970), Sporobolus pyramidatus (Gould, 1965). Also associated were Isocoma drummondii and Ericameria austrotexana, which from personal observation, appear to be salt tolerant. Numerous other species of cacti were found at each site. The most common species found in association with these populations are listed in the following table:

Table 1. Vegetation at black lace cactus populations.

Scientific name ¹	Common name	JW	KB	RE ²
Shrubs and trees				
(Typical mesquite brush constants as described by O'Brien, 1980)				
<u>Acacia rigidula</u>	blackbrush	x	x	x
<u>Acacia smallii</u>	huisache	x	x	x

<u>Aloysia gratissima</u>	whitebrush	x
<u>Celtis pallida</u>	spiny hackberry	x x x
<u>Condalia hookeri</u>	brasil	x x x
<u>Diospyros texana</u>	Texas persimmon	x
<u>Lantana horrida</u>	lantana	x x x
<u>Prosopis glandulosa</u>	mesquite	x x x
<u>Yucca treculeana</u>	Spanish dagger	x x x
<u>Zanthoxylum fagara</u>	colima	x x x
<u>Ziziphus obtusifolia</u>	lote bush	x x x

(Others commonly found)

<u>Acacia greggii</u>	catclaw	x
<u>Acacia schaffneri</u>	huisachillo	x
<u>Berberis trifoliata</u>	agarito	x x
<u>Castela texana</u>	amargosa	x
<u>Colubrina texensis</u>	hog plum	x
<u>Ephedra antisyphilitica</u>	joint fir	x
<u>Jatropha dioica</u>	leatherwood	x x
<u>Lycium berlandieri</u>	wolfberry	x x x
<u>Parkinsonia aculeata</u>	retama	x x
<u>Porlieria angustifolia</u>	guayacan	x x x
<u>Prosopis reptans</u>	tornillo	x
<u>Rivina humilis</u>	pigeonberry	x x x

Cacti ³

<u>Echinocactus texensis</u>	horsecrippler	x x x
<u>Echinocereus reichenbachii v. albertii</u>	black lace	x x x
<u>Ferocactus hamatacanthus</u>	Turk's head	x
<u>Ferocactus setispinus</u>	twisted rib	x x x
<u>Mammillaria heyderi v. hemisphaerica</u>		x x x
<u>Mammillaria longimamma v. sphaerica</u>		x
<u>Opuntia leptocaulis</u>	tasajillo	x x x
<u>Opuntia lindheimeri</u>	prickly pear	x x x
<u>Opuntia compressa</u>	low prickly pear	x

Herbs or subshrubs dominant or distinctive at measuring site

<u>Atriplex klebergorum</u>	saltbush	x
<u>Ericameria austrotexana</u>		x x
<u>Isocoma drummondii</u>	goldenweed	x
<u>Xanthocephalum sphaerocephalum</u>	broomweed	x x x

Grasses common at measuring site

<u>Bouteloua rigidiseta</u>	grama grass	x
<u>Cenchrus ciliaris</u>	buffel grass	x
<u>Digitaria californica</u>	Arizona cottontop	x x x
<u>Digitaria patens</u>	Texas cottontop	x
<u>Eragrostis lugens</u>	morning lovegrass	x
<u>Leptochloa virgata</u>	tropical sprangletop	x x

<u>Monanthochloe</u> <u>littoralis</u>	shoregrass				x
<u>Panicum hallii</u>	Hall's panicum				x
<u>Setaria leucopila</u>	plains bristlegrass	x	x	x	
<u>Sporobolus pyramidatus</u>	whorled dropseed	x	x	x	

¹After Correll and Johnston, 1970, except cacti.

²JW-Jim Wells County, KB-Kleberg County, RE-Refugio County.

³After Benson, 1982.

Biology

Ross (1980) found that each of six varieties of E. reichenbachii, including var. albertii, were self-incompatible. All varieties were found to have a gametic chromosome number of 11.

The dense clustering of black lace cactus within the populations suggests that seed dispersal mechanisms are relatively unspecialized. Seeds probably fall to the ground or are washed to the ground by rainfall as the fruits deteriorate. The small spiny green fruits probably do not attract feeding animals but could be carried on the coats of small fur-bearing animals. The distribution of the populations along streams, suggests that flood waters may be an agent in the establishment of new populations. The tiny seeds will float, but can be made to sink with turbulence.

Bunting, Wright, and Neuenschwander (1980) found Echinocereus reichenbachii (no variety given) showed 94 percent mortality at the end of 3 years after a prescribed burn in Tobosagrass in West Texas. Mortality was due to interactions of fire and other factors. Wildfires were common occurrences across the coastal plains before they were controlled by modern man. How these fires influenced the distribution of Echinocereus reichenbachii and its varieties is unknown.

Some Corpus Christi cactus growers report that plants of variety albertii, especially those from the Refugio County population, have been difficult to grow in greenhouses. One grower noted that she had better results when she grafted them onto other root stock, but even these eventually failed. Richard O. Albert reported transplanting several specimens from the Jim Wells County population to a flower bed near his home in Alice. They grew and flowered for several years, then all died of an unknown cause. Another grower, however, has been successfully growing several plants from the Kleberg County population for more than 5 years. These are grown outdoors in pots, and numerous seedlings accompany the mature plants.

Impacts and Threats

The greatest threat to Echinocereus reichenbachii var. albertii is habitat destruction. It is common practice in the region to clear brush tracts for cultivation or for improved pasture with the planting of coastal Bermuda grass. Brush clearing has partly or completely destroyed three known populations and has recently occurred near several others. Landowners of presently known populations are apparently unaware of the cactus, so land improvements could destroy present populations without the landowners ever knowing it.

Grazing of natural brush tracts has a negative impact on populations. For the grazed population in Jim Wells County, it

was observed that cattle trample plants in open ground with few plants surviving to maturity. The only cacti present were those protected by other vegetation.

Collecting is always a serious threat to any small desirable species of cactus, particularly when combined with large showy flowers as found in E. reichenbachii var. albertii. We know from reports that collectors have taken some specimens from the Refugio County and Kleberg County populations in the past, but no evidence of collecting was seen. TRAFFIC (USA) (Fuller, 1985) analyzed 53 cactus and succulent nursery catalogs and found nine listed Echinocereus reichenbachii var. albertii for sale at prices ranging from \$1.25 to \$3.50. Two catalogs gave the source of the plants as collected. The plants offered may have come from the populations in question. The very close similarity among several varieties (species) and the disagreement among taxonomists, however, suggest that at least some of the plants listed for sale might be other, closely related varieties or species.

The reports we received indicate that the locations for the populations have been rather closely guarded, even by cactus enthusiasts who have collected plants in the past. If the location of these populations became widely known, collecting would no doubt become a major threat. We found no evidence of collecting pressure on any of the populations. The populations all appear to be healthy and reproducing well.

Management and Conservation Efforts

No formal management or conservation efforts have been undertaken for the populations of Echinocereus reichenbachii var. albertii. All of the populations are on private property and the owners are most likely unaware of their presence, or at least of their significance.

The location of the Jim Wells County population is well guarded, known only to Richard O. Albert and a few others with scientific interest. Its access is also limited by a private drive and locked gate. Dr. Albert has attempted to introduce specimens into two similar sites in Jim Wells County. These trials appear to be successful but have not been established long enough to be fully evaluated.

While location of the populations in Refugio County and Kleberg County are known to some cactus enthusiasts, they claim they have not made the locations widely known, and that no plants have been taken since the cactus was listed as endangered. Due to the proximity of the Refugio County population to the Rob and Bessie Welder Wildlife Foundation property, Gene Blacklock, Coordinator of Environmental Education there, has been able to discourage collectors from visiting that site.

Propagation

Propagation now supplants wild collection as the means of obtaining most species of cacti. This seems to be directly related to increased proficiency of artificial propagation and the predominance of seed-grown and clonal plants (Fuller, 1985).

The large number of seedlings found, particularly at the Jim Wells County site, indicate that the seeds germinate well in the wild. The average number of seeds produced per mature plant, the age reproductive maturity is reached, and life expectancy have not been determined.

Our examination of the populations was late in the season after seed dispersal had occurred. Only one deteriorated fruit was found lodged in the crown of a highly branched individual. Only a few seeds were recovered. If seed production in nature is low, taking large quantities of seed for the development of cultivated stock could have a detrimental impact on the population. Seed production could possibly be enhanced by management of a group of plants by hand pollination before seeds are taken.

Clonal propagation is a viable alternative for production of plants for distribution to the trade. Tissue culture laboratories at Texas A&M University at College Station and the University of Texas at Austin have both produced clones of other

cacti. A system for tissue culture propagation of this species needs to be developed.

The limited gene pool of a single clone makes plants produced by the tissue culture method unsuitable for reintroduction into the wild. Plants for this purpose would be better acquired by collecting young plants from across an existing population that has a habitat closely resembling the proposed new habitat, or by growing plants from seeds collected from across the population.

PART II

RECOVERY

Prime Objective

The prime objective of this recovery plan is to describe steps for managing and protecting the essential habitat of Echinocereus reichenbachii var. albertii, and for protecting plants from collecting so that healthy populations can be sustained in their natural habitat at levels where the species can be down-listed to threatened and eventually removed from the Federal endangered species list.

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. Precise criteria for delisting will be established after the success of management at permanently protected populations can be evaluated and a search for additional populations has been carried out.

Step-down Outline

1. Remove threats to Echinocereus reichenbachii var. albertii populations by enforcement of existing regulations and management of the habitat for protection of the variety.

11. Enforce Federal and State endangered species laws.
12. Obtain management rights to the sites.
 121. Provide habitat protection through cooperation with private landowners.
 122. Obtain long-term protection of essential habitat.
13. Develop a monitoring study.
 131. Post signs, when appropriate, to warn against trespassing.
 132. Ensure that grazing does not impact populations.
 133. Ensure that collecting does not impact populations.
 134. Monitor populations for disease or climatic impact from unusual weather conditions.
14. Develop and implement habitat management plans.
15. Locate potential safe habitat for establishment of new populations.
16. Establish populations at botanical gardens.

17. Search for unknown populations of the black lace cactus.
2. Initiate studies on the ecology and population biology of the black lace cactus.
21. Determine the restricting edaphic conditions
22. Determine the pollinator(s) of E. reichenbachii var. albertii and the status of pollinator(s) populations.
23. Study the population dynamics of each known population.
3. Determine the genetic relationships among the three populations and between Echinocereus reichenbachii var. albertii and other closely related taxa.
4. Develop a comprehensive trade management plan for all cacti.
5. Develop cultivated stocks for commercial distribution.
51. Investigate feasibility of large scale production of cultivated seedlings for distribution.
52. Develop procedures for mass production by clonal propagation.
6. Determine delisting criteria.

7. Develop public awareness, appreciation, and support for preservation of the black lace cactus.

Narrative

1. Remove threats to Echinocereus reichenbachii var. albertii populations by enforcement of existing regulations and management of the habitat for protection of the variety.

Because of the rarity of this variety, it should be protected from collecting by enforcement of existing regulations and its habitat should be managed to ensure the continued existence of self-sustaining populations.

11. Enforce Federal and State endangered species laws.

Regulations under the Endangered Species Act of 1973, the Convention on International Trade in Endangered Species, the Lacey Act, and Chapter 88 (Endangered Plants) of the Texas Parks and Wildlife Code should be enforced to the maximum extent possible. Any illegal collecting or trade convictions under these acts should be published in periodicals such as the Cactus and Succulent Journal of America to remind others that the regulations exist and are being enforced.

12. Obtain management rights to the sites.

In order to ensure the continued existence of the populations of black lace cactus, the right to manage the sites is essential.

121. Provide habitat protection through cooperation with private landowners.

To provide for the maintenance of populations on private lands, it will be necessary to obtain the cooperation and good will of the landowners. Once a working agreement is established, cooperative management should be negotiated for the protection of the black lace cactus and its habitat. Such cooperation should include management to improve and enhance existing sites if deemed necessary.

122. Obtain long-term protection of essential habitat

Since all known populations are on private property, with no legal protection from collecting or habitat destruction, it is essential that actions be taken to allow direct habitat protection. Therefore, actions leading to permanent land protection should be considered by FWS, the Nature Conservancy, or other conservation organizations. Protective action by

the FWS would require full NEPA compliance and documentation. The highest priority for protection should go to the Kleberg County population, with the Jim Wells County population next, and the Refugio County population last.

131. Post signs, when appropriate, to warn against trespassing.

"No trespassing" signs should be used where they will be most effective, without drawing attention to the location of the populations being protected.

132. Ensure that grazing does not impact populations.

Any impact from grazing should be analyzed and managed to minimize the negative effects.

133. Ensure that collecting does not impact populations.

Populations should be monitored for signs of collecting. If evidence is found, steps should be taken to curtail this activity.

134. Monitor populations for disease or climatic impact from unusual weather conditions.

Unusual natural occurrences such as severe cold, floods, or insect infestations can devastate populations. When the populations are already few

in number and small in size these natural occurrences may eliminate populations and lead to eventual extinction.

14. Develop and implement habitat management plans.

As more information is gathered on the status of the populations, management plans should be formulated and carried out.

15. Locate potential safe habitat for establishment of new populations.

Several agencies control land within the range of this variety that may have potential suitable habitat. Among these are the Rob & Bessie Welder Foundation in San Patricio County and the Corpus Christi Botanical Society, Inc. in Nueces County. After the edaphic requirements of the black lace cactus are better known, similar sites on such protected properties should be selected for introduction of new populations. In selecting plants for reintroduction, care must be taken to assure as large a gene pool as possible. This can be done by collecting plants or seeds from across the donor population, or from each of the known populations. Clonal plants should not be used unless as a controlled experiment.

16. Establish populations at botanical gardens.

Much biological information can be obtained most easily from a botanical garden collection. In addition, a permanent, well documented, and accessible botanical garden collection, together with appropriate seed banking, would provide an important source of material for non-destructive research, maintenance of wild populations, and public awareness.

17. Search for unknown populations of the black lace cactus.

The locations of the known populations are scattered, and distribution within each site is narrow. Undiscovered populations of black lace cactus may exist on some of the hundreds of similar sites along numerous streams in the five gulf coast counties within the variety's range. Use soil and geology maps and aerial photographs to develop a habitat profile for the black lace cactus. Consult with Soil Conservation Service personnel for recommendations on areas to check. If the number of potential areas is large or if the areas are inaccessible, aerial searches during the blooming period may be the most effective way to locate plants.

2. Initiate studies on the ecology and population biology of the black lace cactus.

In-depth knowledge of the population biology and ecology of the black lace cactus is needed. Some of this information may be critical to future management of the variety.

21. Determine the restricting edaphic conditions.

Information about the soil, climatic, and microhabitat requirements will aid in the management of known populations, in locating new populations, and in choosing reintroduction sites.

22. Determine the pollinator(s) of E. reichenbachii var. albertii and the status of pollinator(s) populations.

The success or failure of a species is directly related to the continued existence of healthy populations of its pollinators. Decline in a population of pollinators can have as large and important an impact on the long-term survival of a given species as edaphic changes, site destruction, or overcollecting. The resulting damage is less visible, and decline is slow and easily overlooked until it is too late.

23. Study the population dynamics of each known population.

A knowledge of demographic trends in the natural populations is needed to effectively manage the variety. Factors involved in seedling establishment should be

determined. Other information relating to the variety's reproductive success that should be gathered includes: the average number of seeds produced per mature individual per season; the germination percentage; and the method of seed dispersal. Permanent quadrats with mapped individuals should be established and censused annually to create depletion and recruitment curves.

3. Determine the genetic relationships among the three populations and between *Echinocereus reichenbachii* var. *albertii* and other closely related taxa.

Knowing the level of classification of *E. reichenbachii* var. *albertii* is not so important as understanding its relationship to its closest relatives. Reliable characteristics that can be used to identify flowering or sterile specimens are essential for enforcement of trade regulations. Determination of the distinctness of the taxon is also imperative since considerable expenditures may be necessary to protect and maintain it in perpetuity. Genetic studies using isozymes and/or flavanoids combined with a thorough morphological analysis can provide evidence on the distinctness or indistinctness of the gene pool within or among the populations under study, and with populations of closely related taxa.

4. Develop a comprehensive trade management plan for all cacti.

Studies are needed to determine what species are in trade, the overall trend of trade in listed cacti, and the feasibility of reducing collecting pressure on wild populations by promoting a commercial, artificial propagation program. These studies should be national in scope and address all cacti. The results will be used to develop policy and a comprehensive trade management plan for all cacti. Strategies for effective implementation of law enforcement responsibilities under ESA, CITES, Lacey Act, and State laws need to be developed.

5. Develop cultivated stocks for commercial distribution.

Cultivated stocks can be developed by authorized, responsible and/or licensed agencies, e.g., botanical gardens, universities, etc., for sale to licensed commercial distributors if information from the trade study indicates this is a practical method of reducing collecting pressure. Such trade will be subject to applicable Federal or State permits and reporting requirements.

51. Investigate feasibility of large scale production of cultivated seedlings for distribution.

Before seeds are collected from the wild for production of stocks on a commercial scale, evaluation of the impact of such collecting should be made (see task 23 & p. 21-22).

52. Develop procedures for mass production by clonal propagation.

The most efficient means of producing large numbers of plants for commercial distribution is microproduction from meristems. Such production would not impact the wild populations and has the added advantage that selected clones with desirable character combinations can be replicated.

6. Determine delisting criteria.

Before the variety can be downlisted to threatened, at least two of the three known populations should be established as safe sites. Criteria for delisting will be established only after the success of management at permanently protected populations can be evaluated and a search for additional populations has been conducted.

7. Develop public awareness, appreciation, and support for preservation of the black lace cactus.

The full recovery of the black lace cactus, and of other endangered species, depends on the attitude and support of the public. Educational materials and presentations should be used to gain public appreciation of the endangered species, and support for the program to save it.

Literature Cited

- Bakeberg, C. 1977. Cactus Lexicon. Blandford Press, Ltd., Poole, Dorset BH15 ILL. (originally published in Germany 1966).
- Benson, L. 1970. Pages 1087-1113 in Correll and Johnston, Manual of the Vascular Plants of Texas. Texas Research Foundation, Renner, Texas.
- _____. 1982. The Cacti of the United States and Canada. Stanford Univ. Press, Stanford, Calif.
- Britton, N.L. and J.N. Rose. 1963. The Cactaceae, Vol. 3. Dover Publications, Inc., N.Y.
- Bunting, S.C., H.A. Wright and L.F. Neuenschwander. 1980. Long term effects of fire on cactus in the southern mixed prairie of Texas. Jour. of Range Management 33(2):85-88.
- Correll, D.S. and M.C. Johnston. 1970. Manual of the Vascular Plants of Texas. Texas Research Foundation, Renner, Texas.
- de la Pena, T. 1969. The influence of soil on the growth responses of "running" and "upright" mesquite seedlings. M.S. thesis, Texas A&I Univ., Kingsville, Texas.

- Fuller, D. 1985. U.S. cactus and succulent business moves toward propagation. *TRAFFIC (USA)* 6(2):1, 3, & 11.
- Gould, F.W. 1965. *Grasses of the Texas Coastal Bend*. Texas A&M University Press, College Station, Texas.
- Huss, D.L. 1959. Brush types of the Nueces River watershed as related to soil, climatic and geological factors. Ph.D. dissertation, Texas A&M Univ., College Station, Texas.
- Jones, F.B. 1982. *Flora of the Texas Coastal Bend*, 3rd edition. Rob and Bessie Welder Wildlife Foundation, Sinton, Texas.
- O'Brien, R. 1980. Woody vegetation of the mesquite-chaparral association of the Texas Coastal Bend. M.S. thesis, Corpus Christi State Univ., Corpus Christi, Texas.
- Ross, R.G. III. 1980. *Studies in the cactaceae*. Ph.D. dissertation, University of Oklahoma, Norman, Oklahoma.
- Weinger, D. 1979. Status Report on Echinocereus reichenbachii var. albertii. U.S. Fish and Wildlife Service, Albuquerque, New Mexico.
- _____. 1984. *Cacti of Texas and Neighboring States - a field guide*. Univ. of Texas Press, Austin, Texas.

Wilkinson, D. 1977. Vegetation resource investigation
of Caesalpinia drummondii and Echinocereus reichenbachii
var. albertii on the Choke Canyon Reservoir site, Nueces
River Project, Texas, Vol. I. USDI, Bureau of Reclamation,
Amarillo, Texas.

PART III

IMPLEMENTATION SCHEDULE

The Implementation Schedule that follows outlines actions and costs for the black lace cactus recovery program. It is a guide to meeting the objectives elaborated in Part II of this plan. This schedule indicates the general category for implementation, recovery plan tasks, corresponding outline numbers, task priorities, duration of tasks ("on-going" denotes a task that once begun should continue on an annual basis), which agencies are responsible to perform these tasks, and lastly, estimated costs for FWS tasks. These actions, when accomplished, should bring about the recovery of the black lace cactus and protect its habitat. It should be noted that monetary needs for agencies other than FWS are not identified and therefore, Part III may not reflect the total financial requirements for the recovery of these cacti.

General Categories for Implementation Schedule

Information Gathering - I or R (research)

1. Population status
2. Habitat status
3. Habitat requirements
4. Management techniques
5. Taxonomic studies
6. Demographic studies
7. Propagation
8. Migration
9. Predation
10. Competition
11. Disease
12. Environmental contaminant
13. Reintroduction
14. Other information

Acquisition - A

1. Lease
2. Easement
3. Mgmt. Agrt.
4. Exchange
5. Withdrawal
6. Fee title
7. Other

Other - 0

1. Information and education
2. Law enforcement
3. Regulations
4. Administration

Management - M

1. Propagation
2. Reintroduction
3. Habitat maintenance and manipulation
4. Predator and competitor control
5. Depredation control
6. Disease control
7. Other management

Recovery Action Priorities

- 1 = an action that must be taken to prevent extinction or to prevent the species from declining irreversibly in the foreseeable future.
- 2 = an action that must be taken to prevent a significant decline in species population/habitat quality, or some other significant negative impact short of extinction.
- 3 = all other actions necessary to provide for full recovery of the species.

Abbreviations Used

- FWS - USDI Fish and Wildlife Service
 SE - Office of Endangered Species
 LE - Law Enforcement
 RE - Realty
 TNHP - Texas Natural Heritage Program

IMPLEMENTATION SCHEDULE

GENERAL CATEGORY	PLAN TASK	TASK #	PRIORITY	# TASK DURATION	RESPONSIBLE AGENCY		FISCAL YEAR COSTS (EST.)*			COMMENTS
					FWS	OTHER	FY1	FY2	FY3	
02	Enforce existing regulations	11	2	ongoing	2	SELE	2,500	2,500	2,500	
A3	Provide habitat protection through private landowners	121	1	2 years	2	SE RE	1,000	1,000		
A7	Obtain long-term protection of essential habitat	122	1	2 years	2	SE RE	6,000	6,000		41
M3	Post non-trespassing signs	131	2	1 year	2	SE	500			
M3	Monitor for grazing impacts	132	2	ongoing	2	SE	1,000	1,000	1,000	
M3	Monitor for collecting impacts	133	2	ongoing	2	SE	1,000	1,000	1,000	

*Costs refer to USFWS expenditures only.

IMPLEMENTATION SCHEDULE (continued)

GENERAL CATEGORY	PLAN TASK	TASK #	PRIORITY	# TASK DURATION	RESPONSIBLE AGENCY	FISCAL YEAR COSTS (EST.)*			COMMENTS
						OTHER			
						FWS	FY1	FY2	
M3	Monitor for disease or other natural impacts	134	2	ongoing	SE	1,000	1,000	1,000	
M3	Develop and implement habitat management plans	14	2	ongoing	SE		5,000		
I13	Locate safe sites for potential reintroductions	15	2	2 years	SE		2,500	2,500	
I14	Establish botanical garden populations	16	2	3 years	SE		2,000	2,000	2,000
I14	Search for new populations within the range of the variety	17	2	ongoing	SE		5,000	5,000	5,000

*Costs refer to USFWS expenditures only.

IMPLEMENTATION SCHEDULE (continued)

GENERAL CATEGORY	PLAN TASK	TASK #	PRIORITY	# TASK DURATION	RESPONSIBLE AGENCY	FISCAL YEAR COSTS (EST.)*			COMMENTS
						OTHER			
						FY1	FY2	FY3	
I3	Determine edaphic requirements for the variety	21	2	ongoing	SE	2,500	2,500	2,500	
I6	Determine pollinators	22	2	3 years	SE	2,000	2,000	2,000	
I6	Study population dynamics of known populations	23	2	5 years	SE	10,000	6,000	6,000	
I5	Determine genetic relationships with closely related taxa	3	2	3 years	SE	10,000	10,000	10,000	
I14	Develop a trade management plan for all cacti	4	2	1 year	SE	20,000			
I7	Investigate feasibility of large scale production of cultivated seedlings	51	3	3 years	SE	5,000	5,000	5,000	

*Costs refer to USFWS only.

IMPLEMENTATION SCHEDULE (continued)

GENERAL CATEGORY	PLAN TASK	TASK #	PRIORITY	# TASK DURATION	RESPONSIBLE AGENCY	FISCAL YEAR COSTS (EST.)*			COMMENTS
						OTHER			
						FWS	FY1	FY2	
REGION PROGRAM									
I 7	Develop procedures for clonal propagation	52	3	3 years	2 SE	5,000	5,000	5,000	5,000
0 3	Determine delisting criteria	6	3	1 year	2 SE				500
0 1	Develop public awareness	7	2	ongoing	2 SE	2,000	2,000	2,000	2,000

*Costs refer to USFWS only.

APPENDIX

List of Reviewers

A technical/agency review draft of the Black Lace Cactus Recovery Plan was sent to the following individuals and agencies on April 4, 1986.

Ms. Jackie Poole, Texas Natural Heritage Program, Austin, TX

Mr. James G. Teer, Welder Wildlife Foundation, Sinton, TX

Dr. William Mahler, Southern Methodist University, Dallas, TX

Mr. David Riskind, Texas Parks and Wildlife Department,
Austin, TX

Mr. Gary Valentine, U.S. Soil Conservation Service, Temple, TX

Dr. Richard Worthington, The University of Texas at El Paso,
El Paso, TX

Dr. Elray Nixon, Stephen F. Austin State University, Nacogdoches,
TX.

Mr. Andrew Sansom, The Texas Nature Conservancy, San Antonio, TX

Dr. Allan Zimmerman, Chihuahuan Desert Research Institute, Alpine,
TX

Mr. Harold Beaty, Temple, TX

Executive Director, Texas Parks and Wildlife Department,
Austin, TX

Regional Supervisor, Realty, USFWS, Region 2

Special Agent in Charge, Law Enforcement, USFWS, Region 2

Refuge Supervisor Zone III, USFWS, Region 2

Field Supervisor, Ecological Services, Corpus Christi Field
Office, USFWS, Region 2

Director (AFA/OES), Office of Endangered Species, USFWS,
Washington, D.C.

Director (WR), Division of Research, USFWS, Washington, D.C.

Comments Received

Comment letters are reproduced in this section followed by the Service's response to each comment. Some reviewers submitted part or all of their comments marked directly on the draft plan. These comments, which were mostly editorial in nature, have not been reproduced.



United States Department of the Interior

FISH AND WILDLIFE SERVICE
WASHINGTON, D.C. 20240

ADDRESS ONLY THE DIRECTOR,
FISH AND WILDLIFE SERVICE

In Reply Refer To:
FWS/OES

AUG - 8 1986

~~RD~~
~~DRD~~
~~AA~~
 AFF
~~AWR~~
~~AHR~~
~~LE~~
~~PAO~~
~~EEO~~
~~FILE~~
 Action *SE*
~~CL-2-186~~

Memorandum

To: Regional Director, Region 2 (ARD/AFF)
Acting Deputy Assistant
From: Director

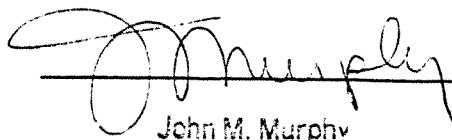
Subject: Black Lace Cactus Recovery Plan - Technical/Agency Draft

The attached subject draft recovery plan has been reviewed and found to be well prepared. Minor editorial changes/corrections are indicated on pages 2, 6, 7, 14, and 16. In addition to these specific comments, the following additional comments are offered:

1. The last paragraph on page 3 states that the plan will describe "past...distribution". There is not any further discussion of the historical distribution of the plant. If the first sentence on page 3 refers to historical distribution as well as present distribution, please add a statement indicating that this is the case. A-1
2. Page 28, Task 122 - Delete the last sentence referencing Land Protection Plans (LPP). The Service no longer uses LPP's for proposed land acquisition. See attached memorandum of December 26, 1985. A-2
3. Page 31, Task 162 - Delete this task. It is stated on page 19 that collection or taking is a real or potential threat to this cactus. To publicize that the cactus is in bloom, i.e., task 162, would probably do more harm than good since collectors would be alerted as to when the cactus is most visible. A-3
4. Page 38, "O'Brien, R. 1980" is referenced in the Literature Cited. Is O'Brien cited in the text? A-4

These comments are offered to assist you in developing the final draft.

Attachment


John M. Murphy

TEXAS NATURAL HERITAGE PROGRAM
 STEPHEN F. AUSTIN BUILDING
 1700 NORTH CONGRESS
 AUSTIN, TEXAS 78701

June 3, 1986

Dr. Charles McDonald
 U.S. Fish and Wildlife Service
 P.O. Box 1306
 Albuquerque, New Mexico 87103

Dear Charlie,

I have reviewed the technical/agency review draft recovery plan for the black lace cactus (Echinocereus reichenbachii var. albertii). The following comments have been coordinated between the Texas Natural Heritage Program and the Texas Parks and Wildlife Department.

In order to more efficiently search for unknown populations B-1 as well as locate potential safe habitat for new population establishment, the habitat requirements need to be determined first. Soils and geology maps and aerial photographs as well as SCS personnel should be consulted to determine a more specific search profile. Such study should delimit fewer areas to check, and probably eliminate the need for aerial search.

The black lace cactus is protected by state law. This B-2 should be added to both the step-down outline and the narrative, section II. Also the recent SCS farm bill legislation (the "sod B-3 buster" bill) might be useful in protecting the species in marginal habitats.

In section 162, an "Endangered Species Hotline" is B-4 mentioned. The Texas Natural Heritage Program currently has an in-state 800 number (252-RARE). The Program would be glad to allow the use of this line for this function.

Sincerely,

Jackie

Jackie M. Poole
 Botanist, Texas Natural Heritage Program

cc: Dorinda Rice

JMP:mt

TNHS REG 2
 RECEIVED

JUN 5 '86

SE

OPTIONAL FORM NO. 10
MAY 1962 EDITION
GSA FPMR (41 CFR) 101-11.6

UNITED STATES GOVERNMENT

Memorandum

U.S. FISH & WILDLIFE SERVICE
Region 2, Albuquerque, New Mexico 87103

TO : Chief, Endangered Species, Region 2 (SE)

DATE: April 18, 1986

LA-Endangered Species

FROM : Assistant Regional Supervisor, Region 2 (RE)

SUBJECT: Review of Technical/Agency Review Draft Recovery Plan for the Black Lace Cactus

End. Sp. R-2	
JOHNSON	
Burton	
Carley	
Hoffman	
Lewis	
McDonald	1/6
Claywell	1/2
Johnson	1/2
Stull	
Stufferud	
PADILLA	
Carley	

We have reviewed the subject plan and formulated the following comments for your consideration:

- The populations to be protected should be ranked as to priority for protection efforts. C-1
- We recommend that the search for other populations of the cactus be given higher priority. C-2
- The Fish and Wildlife Service no longer prepares Land Protection Plans. This sentence should be omitted and replaced by the following: "Protective actions by the FWS would require full NEPA compliance and documentation." C-3

Thank you for the opportunity to review and comment on this recovery plan.



Larry A. Dunkeson

FWS REG 2
RECEIVED

APR 21 '86

SE

Responses to Comments

- A-1 The plan does not contain a specific section on past distribution but there are comments about past distribution (i.e. extirpated populations) in the section on current status of populations. To avoid confusion, the reference to past distribution on page 3 has been deleted.
- A-2 Correction was made.
- A-3 This task is being deleted.
- A-4 All references have been checked to insure that the text corresponds with the literature cited section.
- B-1 Suggestions was incorporated.
- B-2 Suggestion was incorporated.
- B-3 Comment noted.
- B-4 Suggestion was incorporated.
- C-1 Suggestion was incorporated.
- C-2 Suggestion was incorporated. These tasks have been changed from priority 3 to priority 2.
- C-3 Correction was made.
- D-1 Corrections were made.
- D-2 All references have been checked to insure that the text corresponds with the literature cited section.
- D-3 Suggestion was incorporated.
- D-4 Suggestion was incorporated.