Lloyd's Mariposa Cactus
(*Sclerocactus mariposensis* (Hester) N.P. Taylor)
5-Year Status Review: Summary and Evaluation

U.S. Fish and Wildlife Service
Austin Ecological Services Field Office
Austin, Texas
July 21, 2025

5-YEAR REVIEW
Lloyd's Mariposa Cactus (*Sclerocactus mariposensis* (Hester) N.P. Taylor)

1.0 GENERAL INFORMATION

1.1 Reviewers:

Lead Regional or Headquarters Office:
Angela Anders, Branch Supervisor, Recovery and Restoration, Southwest Regional Office, Albuquerque, New Mexico, angela_anders@fws.gov

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Cooperating Field Office(s):
Not Applicable

Cooperating Regional Office(s):
Not Applicable

1.2 Purpose of 5-Year Reviews:

The U.S. Fish and Wildlife Service (USFWS) is required by section 4(c)(2) of the Endangered Species ESA (ESA) to conduct a status review of each listed species once every 5 years. The purpose of a 5-year review is to evaluate whether or not the species' status has changed since it was listed (or since the most recent 5-year review). Based on the 5-year review, we recommend whether the species should be removed from the list of endangered and threatened species, be changed in status from endangered to threatened, or be changed in status from threatened to endangered. Our original listing as endangered or threatened is based on the species' status considering the five threat factors described in section 4(a)(1) of the ESA. These same five factors are considered in any subsequent reclassification or delisting decisions. In the 5-year review, we consider the best available scientific and commercial data on the species and focus on new information available since the species was listed or last reviewed. If we recommend a change in listing status based on the results of the 5-year review, we must propose to do so through a separate rule-making process including public review and comment.

1.3 Methodology used to complete the review:

The USFWS provides notice of status reviews via the *Federal Register* and requests new information on the status of the species (e.g., life history, habitat conditions, and threats). Data for this status review were solicited from interested parties through a *Federal Register* notice announcing this review on January 11, 2023 (88 FR 1602). The Austin Ecological Services Field Office conducted this review and considered both new and previously

existing information from federal and state agencies, non-governmental organizations, academia, and the public. Primary sources of information used in this analysis were 1) Element Occurrence (EO) records and spatial data from the Texas Parks and Wildlife Department (TPWD) Texas Natural Diversity Database (TXNDD); 2) a recently completed traditional section 6-funded population study at Big Bend National Park (BIBE), which provided the first quantitative estimates of the species' population size at the park; and 3) spatial data from state and federal agencies in the U.S. and Mexico, including Digital Elevation Models (DEMs), soil surveys, surface geology, and protected natural areas in both Texas and Mexico. We also reviewed all new, available scientific literature on the species and communicated with several of its leading experts.

Background:

1.3.1 FR Notice citation announcing initiation of this review:

88 FR 1602

1.3.2 Listing history:

Original Listing
FR notice: 44 FR 64247
Date listed: December 6, 1979
Entity listed: *Neolloydia mariposensis*
Classification: Threatened

Revised Listing, if applicable
Not Applicable

1.3.3 Associated Rulemakings:

86 FR 67352; Scientific name revised to *Sclerocactus mariposensis*.

1.3.4 Review History:

Lloyd's mariposa cactus 5-Year Review, July 6, 2018 (USFWS 2018, entire).

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

14C

1.3.6 Recovery Plan or Outline

Name of plan or outline: Lloyd's Mariposa Cactus (*Neolloydia mariposensis*) Recovery Plan (USFWS 1989)
Date issued: April 13, 1990
Dates of previous plans/amendment or outline, if applicable: Not Applicable

2.0 REVIEW ANALYSIS

Section 4 of the ESA (16 U.S.C. 1533) and its implementing regulations (50 CFR part 424) set forth the procedures for determining whether a species meets the definition of "endangered species" or "threatened species." The ESA defines an "endangered species" as a species that is "in danger of extinction throughout all or a significant portion of its range," and a "threatened species" as a species that is "likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range." The ESA requires that we determine whether a species meets the definition of "endangered species" or "threatened species" due to any of the five factors described below.

Section 4(a) of the ESA describes five factors that may lead to endangered or threatened status for a species. These include: A) the present or threatened destruction, modification, or curtailment of its habitat or range; B) overutilization for commercial, recreational, scientific, or educational purposes; C) disease or predation; D) the inadequacy of existing regulatory mechanisms; or E) other natural or manmade factors affecting its continued existence.

The identification of any threat(s) does not necessarily mean that the species meets the statutory definition of an "endangered species" or a "threatened species." In assessing whether a species meets either definition, we must evaluate all identified threats by considering the expected response of the species, and the effects of the threats—in light of those actions and conditions that will ameliorate the threats—on an individual, population, and species level. We evaluate each threat and its expected effects on the species, then analyze the cumulative effect of all of the threats on the species as a whole. We also consider the cumulative effect of the threats in light of those actions and conditions that will have positive effects on the species—such as any existing regulatory mechanisms or conservation efforts. The USFWS recommends whether the species meets the definition of an "endangered species" or a "threatened species" only after conducting this cumulative analysis and describing the expected effect on the species now and in the foreseeable future.

2.1 Distinct Population Segment (DPS) policy (1996):

Not Applicable

2.2 Updated Information and Current Species Status

2.2.1 Biology and Habitat

2.2.1.1 New information on the species' biology and life history:

No new information.

2.2.1.2 Abundance, population trends (e.g. increasing, decreasing, stable), demographic features (e.g., age structure, sex ratio, birth rate, seed set, germination rate, age at mortality, mortality rate, etc.), or demographic trends:

Four ESA-listed plant species occur at Big Bend National Park (BIBE): Lloyd's mariposa cactus, Chisos hedgehog cactus (*Echinocereus chisoensis*), bunched cory cactus (*Coryphantha ramillosa*), and Guadalupe fescue (*Festuca ligulata*). Beginning in the 1990s, researchers established monitoring plots for these species that were monitored annually by researchers and BIBE personnel. The monitoring plot populations of all four species had declined by 2016; based on these declines, park personnel asked USFWS whether the three cactus species should be reclassified from threatened to endangered. In response to this request, Texas Parks and Wildlife Department (TPWD) awarded a section 6 grant to the Whiting and Fowler (2022, entire) project described below.

Population sizes and demographic trends—the species' resilience—are essential components of a species' conservation status. However, like many rare plant species, Lloyd's mariposa cactus has extremely uneven (patchy) distribution; this greatly complicates population size estimates. The monitoring plots that Anderson and Schmalzel (1997, pp. 6–7) established at BIBE were intentionally placed where they had found dense clusters of Lloyd's mariposa cactus individuals (discussed in the 2018 5-year review). These monitoring plot studies yielded important information on the species' life history. Unfortunately, data from these plots cannot be validly extrapolated to total population sizes or be used to accurately estimate demographic trends because their placement was biased, and therefore does not adequately represent the populations. Furthermore, dense clusters of cactus individuals are more vulnerable to decline due to density-dependent parasitism or herbivory (Anderson and Schmalzel 1997, p. 19). For example, dense populations of Tobusch fishhook cactus (*Sclerocactus brevihamatus* ssp. *tobuschii*), a congener of Lloyd's mariposa cactus, are more likely to incur catastrophic declines due to beetle and weevil parasites (USFWS 2017, pp. 11–12, 39–40). Consequently, population estimates based on monitoring plots that are established specifically where there are dense clusters of individuals often lead to spurious conclusions that total populations are declining.

To address this problem, Whiting and Fowler (2022, pp. 25–58) estimated the total population size of Lloyd's mariposa cactus at BIBE using transects distributed throughout the areas with suitable habitat characteristics. These habitat characteristics were determined from the attributes of known populations at BIBE and Black Gap Wildlife Management Area (BGWMA). The area of suitable habitat was based on the elevation range and occupied Soil Map Units (Natural Resources Conservation Service (NRCS) 2023a, 2023b, 2023c, 2023d) listed in Table 1. The total sample universe for Lloyd's mariposa cactus (the area within which transects were distributed) at BIBE was 60,119 hectares (ha) (148,555 acres (ac); Figure 2). Transect distribution was pre-determined in ArcMap with a north to south orientation and an unbiased regular spacing of 400 meters (m) (1,312 feet (ft); Figure 2). Three or more surveyors collected transect data over two weeks in March 2019 and March 2022 (Whiting and Fowler 2022, p. 30;

Figure 1.5). These periods coincided with peak flowering, which aids detection and identification of this cryptic cactus; due to its small size and grayish appearance, it blends in with the limestone substrate. The transects totaled 13,832 m (45,379 ft) in length and 100,004 m^2 (1,076,405 ft^2) in area (Whiting and Fowler 2022, p. 38). Each surveyor covered a 2-m (6.6-ft) width of the transect and an average of 2.8 ha (6.8 ac) per field day. A total of 172 Lloyd's mariposa cactus individuals were detected within transect boundaries, as well as 120 individuals observed outside transect boundaries (Whiting and Fowler 2022, pp. 25–58 and attached spreadsheets). Individuals occurred sporadically on 22 of 31 transects; the locations of transected individuals are not shown in Figure 2. The extrapolated total population (based only on the numbers observed within transects) within BIBE is 1,034,015 individuals (Whiting and Fowler 2022, pp. 30, 38). The documented populations are distributed in 5 or more metapopulations.

However, due to the large area of the sampling universe, the limited number of surveyors, and the remoteness of much of the sampling universe, transects covered only 0.02 percent of the sampling universe (Whiting and Fowler 2022, pp. 30, 33). Although these authors did not determine confidence intervals for the extrapolated total population, the intervals would likely be very large. The extrapolated population would thus be lower if the species is not present in large portions of the sampling universe that were not transected. For example, due to the remote location and challenging terrain, the authors were not able to sample transects in the Sierra del Caballo Muerto, on the east side of BIBE.

An alternative interpretation of the Whiting and Fowler transect data would be to restrict the extrapolated population more closely to the transected areas. Since transects were 400 m apart, the most restrictive interpretation of the sampled area would be a 200-m (656-ft) buffer around each transect, which has a total area of 855.7 ha (2,114 ac). The transects cover 1.2 percent of this area, and the extrapolated total population would be 14,718 individuals. This more conservative population estimate is nevertheless from 7 to 10 times greater than the Minimum Viable Population (MVP) level of 1,500 to 2,000 individuals that we previously estimated (USFWS 2018, pp. 16–17); this estimate was based on a modification of the method in Pavlik (1996, p. 137). This restrictive interpretation does not mean that this is the total population within the area of potential habitat at the park; it is very likely that many more plants occur in the unsampled portions of the potential habitat. Therefore, the actual population size within BIBE is likely to be at least 14,718 individuals and may be over 1,000,000 individuals.

Whiting and Fowler (2022, pp. 30–31) also observed Lloyd's mariposa cactus at previously documented locations east of BIBE, at BGWMA, and west of the park, between Study Butte and Lajitas. Subsequently, Whiting (2023a, entire plus attachments; 2023b, entire plus attachments) documented the species at several new locations at BIBE (indicated in Figure 2). The continued discovery of the species in new locations within, but not beyond, the sampling universe is additional evidence that the sampling universe is a useful model of the species' distribution.

Strong and Manley (2024) noted that potential habitat maps based on geological formations (discussed in 2.3.1.6) extend into the southeast corner of Big Bend Ranch State Park (BBRSP). They used methods similar to those of Whiting and Fowler (2022) to sample representative plots in that portion of BBRSP. They found 10 Lloyd's mariposa cactus individuals in one of 16 plots, from which they extrapolated a total population of 3,539. They also observed 28 individuals near but not within several plots.

Table 1. Comparison of potential habitat models for Lloyd's mariposa cactus. Symbols in potential habitat model columns indicate the Soil Survey Areas[1] and the specified soil map units and geological strata that were included in the model.

1. NRCS 2023a, 2023b, 2023c, 2023d.
2. BIBE = Big Bend National Park; Br = Brewster County; Pr = Presidio County; Te = Terrell County.
3. Stoeser *et al*. 2005.
4. Servicio Geológico Mexicano 2008a, 2008b.
5. Discussed in Section 2.2.1.6.

Occupied Soil Map Units[1] and geological strata[3,4]	**USFWS 2018[2]**	**Whiting and Fowler 2022[2]**	**USFWS 2025a[2,5]**	**USFWS 2025b[5]**
Blackgap-rock outcrop complex 1–70% slope	BIBE, Br, Pr	BIBE	BIBE, Br, Pr	
Blackgap soils and rock outcrop 3–45% slope			Te	
Ector rock outcrop complex 1–60% slope			Te	
Geefour silty clays complex 3–45%	BIBE, Br, Pr	BIBE	BIBE, Br, Pr	
Leyva Rock Outcrop Complex 10–30% Slope	BIBE		BIBE	
Lozier-rock outcrop complex 3–70%			Br	
Lozier soils			Te	
Mariscal very channery loam 1–8% slope	BIBE, Br	BIBE	BIBE, Br	
Mariscal-rock outcrop complex 5–30% slope	BIBE, Br, Pr	BIBE	BIBE, Br, Pr	
Strawhouse-Stillwell complex 1–30% slope	BIBE, Br	BIBE	BIBE, Br	

Occupied Geological Strata				
Santa Elena Limestone				Texas
Boquillas Formation				Texas
Santa Elena/Sue Peaks/Del Carmen/Telephone Canyon				Texas
Buda Limestone/Del Rio Clay				Texas
Sue Peaks/Del Carmen/Telephone Canyon				Texas
Penn				Coahuila-Chihuahua
San Vicente				Coahuila-Chihuahua
Boquillas/Ojinaga				Coahuila-Chihuahua
Buda				Coahuila-Chihuahua
Del Rio				Coahuila-Chihuahua
Washita Group				Coahuila-Chihuahua
Santa Elena/Loma de Plata				Coahuila-Chihuahua
Benavides				Coahuila-Chihuahua
Finlay/Bronce				Coahuila-Chihuahua
Aurora				Coahuila-Chihuahua
Edwards				Coahuila-Chihuahua
La Peña				Coahuila-Chihuahua
La Mula				Coahuila-Chihuahua
Elevation Range (m)[5] Elevation Range (ft)	750–1,150 2,461–3,773	750–1,150 2,461–3,773	650–1,150 2,133–3,773	650–1,150 2,133–3,773
Total (ha)	219,828	60,119	557,552	815,575
Total (ac)	543,194	148,555	1,377,712	2,015,286

Figure 1. Photographic images of Lloyd's mariposa cactus.

1.1. Note curved, darkened central spines and darkened mid-rib of outer tepal.

1.2, 1.3, and cover: Variation in floral color and morphology.

1.4. Habitat at APFF Ocampo, Coahuila.

1.5. Lloyd's mariposa cactus survey transect at Mesa de Anguila, Big Bend National Park.

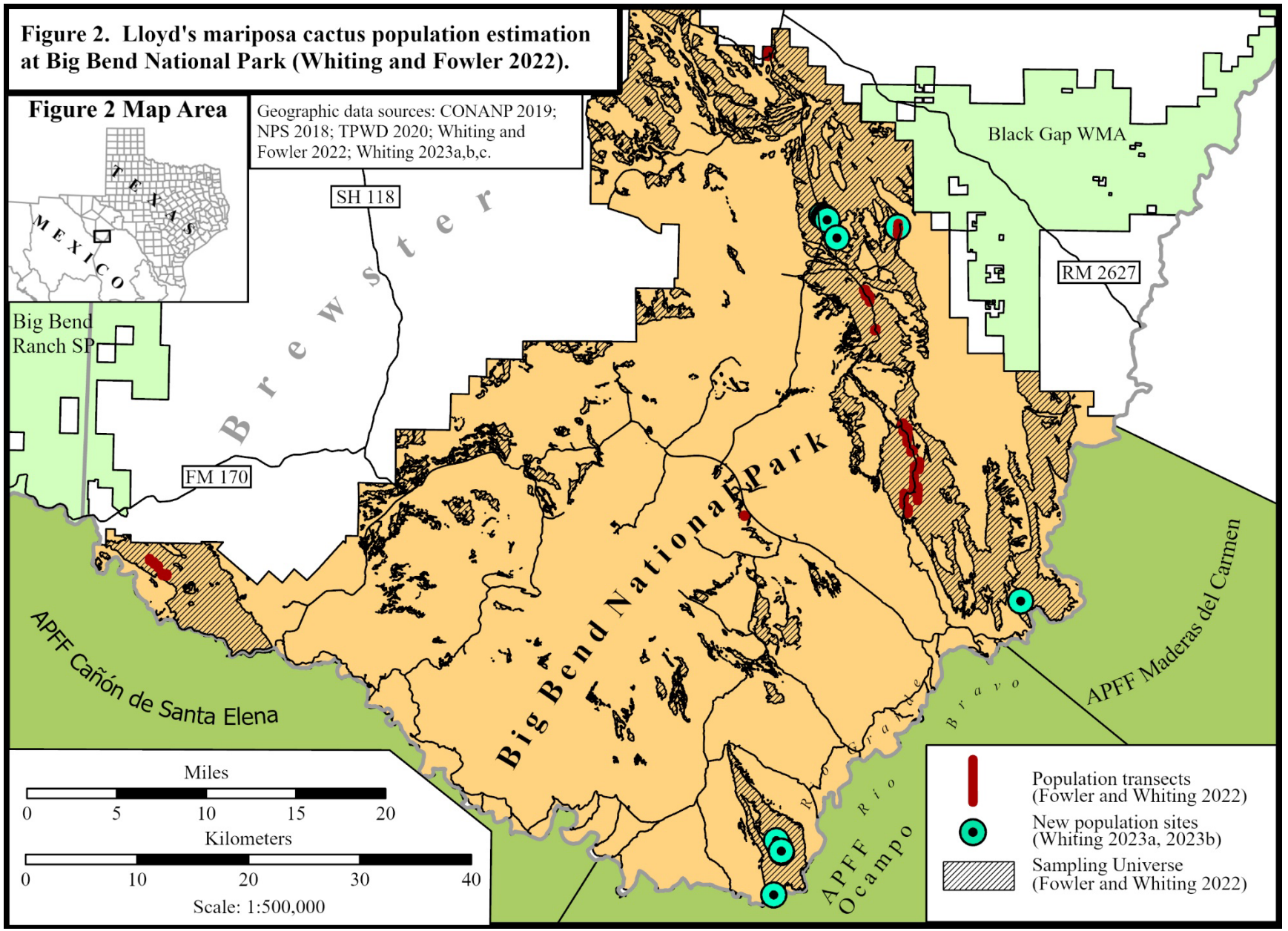


Figure 2. Lloyd's mariposa cactus population estimation at Big Bend National Park (Whiting and Fowler 2022).
Figure 2 Map Area
TEXAS
MEXICO
Geographic data sources: CONANP 2019; NPS 2018; TPWD 2020; Whiting and Fowler 2022; Whiting 2023a,b,c.
SH 118
Brewster
Big Bend Ranch SP
FM 170
Black Gap WMA
RM 2627
Big Bend National Park
APFF Cañón de Santa Elena
APFF Maderas del Carmen
APFF Ocampo
Río Grande
Río Bravo
Miles
0 5 10 15 20
Kilometers
0 10 20 30 40
Scale: 1:500,000
Population transects (Fowler and Whiting 2022)
New population sites (Whiting 2023a, 2023b)
Sampling Universe (Fowler and Whiting 2022)

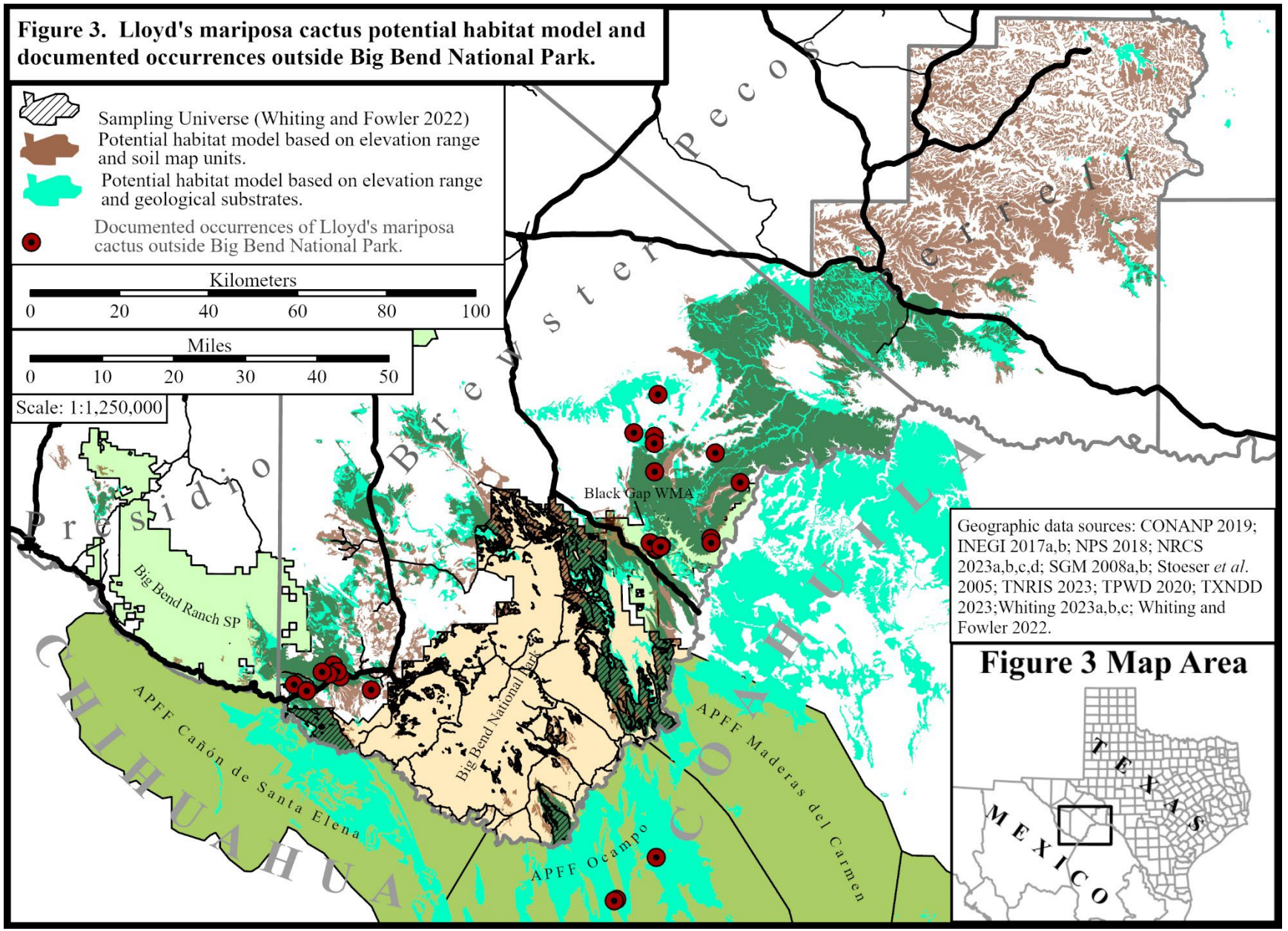


Figure 3. Lloyd's mariposa cactus potential habitat model and documented occurrences outside Big Bend National Park.
Sampling Universe (Whiting and Fowler 2022)
Potential habitat model based on elevation range and soil map units.
Potential habitat model based on elevation range and geological substrates.
Documented occurrences of Lloyd's mariposa cactus outside Big Bend National Park.
Kilometers
0 20 40 60 80 100
Miles
0 10 20 30 40 50
Scale: 1:1,250,000
Presidio
Brewster
Pecos
Terrell
Black Gap WMA
Big Bend Ranch SP
Big Bend National Park
APFF Cañón de Santa Elena
APFF Ocampo
APFF Maderas del Carmen
CHIHUAHUA
COAHUILA
Geographic data sources: CONANP 2019; INEGI 2017a,b; NPS 2018; NRCS 2023a,b,c,d; SGM 2008a,b; Stoeser et al. 2005; TNRIS 2023; TPWD 2020; TXNDD 2023;Whiting 2023a,b,c; Whiting and Fowler 2022.
Figure 3 Map Area
TEXAS
MEXICO

2.2.1.3 Genetics, genetic variation, or trends in genetic variation (e.g., loss of genetic variation, genetic drift, inbreeding, etc.):

No new information.

2.2.1.4 Taxonomic classification or changes in nomenclature:

In the 2018 5-year review, we reported that Porter and Prince (2011, pp. 174, 178), in a draft report to the USFWS Division of Scientific Authority, presented evidence based on molecular phylogenetics indicating that the genus *Echinomastus* is paraphyletic. They placed *Echinomastus*, *Ancistrocactus*, and *Toumeya* within a broadly defined, monophyletic genus *Sclerocactus*; *Glandulicactus* remained as a separate genus. We have adopted this classification for Lloyd's mariposa cactus. Although the Porter and Prince report per se has not been published in a peer-reviewed journal, the phylogenetic data was published in Baker and Porter (2016, all), described below.

Baker and Porter (2016, pp. 32–24) published the phylogenetic analyses that Porter and Prince described in their report to USFWS in 2011. Based on *trnL-F* chloroplast DNA sequence data, they reiterate that the strict interpretation of *Sclerocactus* is a monophyletic clade, but that renders *Echinomastus* as paraphyletic; both *Sclerocactus* and *Echinomastus* share a common ancestor. Their analysis supports a broader delimitation of *Sclerocactus* that includes *Echinomastus* and *Ancistrocactus*. As before, the genus *Glandulicactus* was preserved as a separate valid taxon. Interestingly, this phylogeny did not consider the genus *Toumeya*. (Although this work published as a book chapter in 2016, we were not aware of this information until after the 2018 5-year review was completed). We also communicated with Porter (2023, all), who confirmed that *Echinomastus* should be considered paraphyletic and its species included within *Sclerocactus*.

Tropicos (2025a, entire; Tropicos 2025b, entire) lists both *Echinomastus mariposensis* and *Sclerocactus mariposensis* as accepted names; however, the Tropicos articles do not include Baker and Porter (2016) in the references cited.

For these reasons, we continue to recognize Lloyd's mariposa cactus as *Sclerocactus mariposensis* (Hester) N.P. Taylor. Porter and Prince (2011, pp. 174, 178) also concluded that populations in central and southern Coahuila should not be included within *S. mariposensis*. However, this finding has not yet been published in a peer reviewed journal (Porter 2023). Martínez-Avalos *et al*. (2020, p. 68), Flores Vazquez *et al*. (2020, p. 122), and Ochoterena *et al*. (2020, p. 156) continue to refer to these populations as *Echinomastus* or *Sclerocactus mariposensis*. Therefore, for the purpose of this review, we consider the status of the listed entity as the broader delimitation of *S. mariposensis* that includes the central and southern Coahuilan populations (see Figure 4).

2.2.1.5 Spatial distribution, trends in spatial distribution (e.g. increasingly fragmented, increased numbers of corridors, pollinator availability, etc.), or historic range (e.g. corrections to the historical range, change in distribution of the species' within its historic range, etc.):

The TXNDD (2023) lists 28 EOs in Texas, of which 13 are within BIBE, three are within BGWMA, and 12 are on private properties outside the park (Figure 3). The 13 EOs within BIBE can be grouped into at least 5 distinct population clusters (metapopulations), and the recent transect data indicate that population sizes are much larger than previously known. This could justify combining multiple EOs into a smaller number of EOs with larger, more viable population sizes. For example, under the strict interpretation described above of the Whiting and Fowler transect data (14,718 individuals), the five population clusters would have an average size of nearly 3,000 individuals—greater than our estimated MVP of 1,500 to 2,000 individuals. It is very likely that more populations occur elsewhere at BIBE within potential habitats that were not sampled.

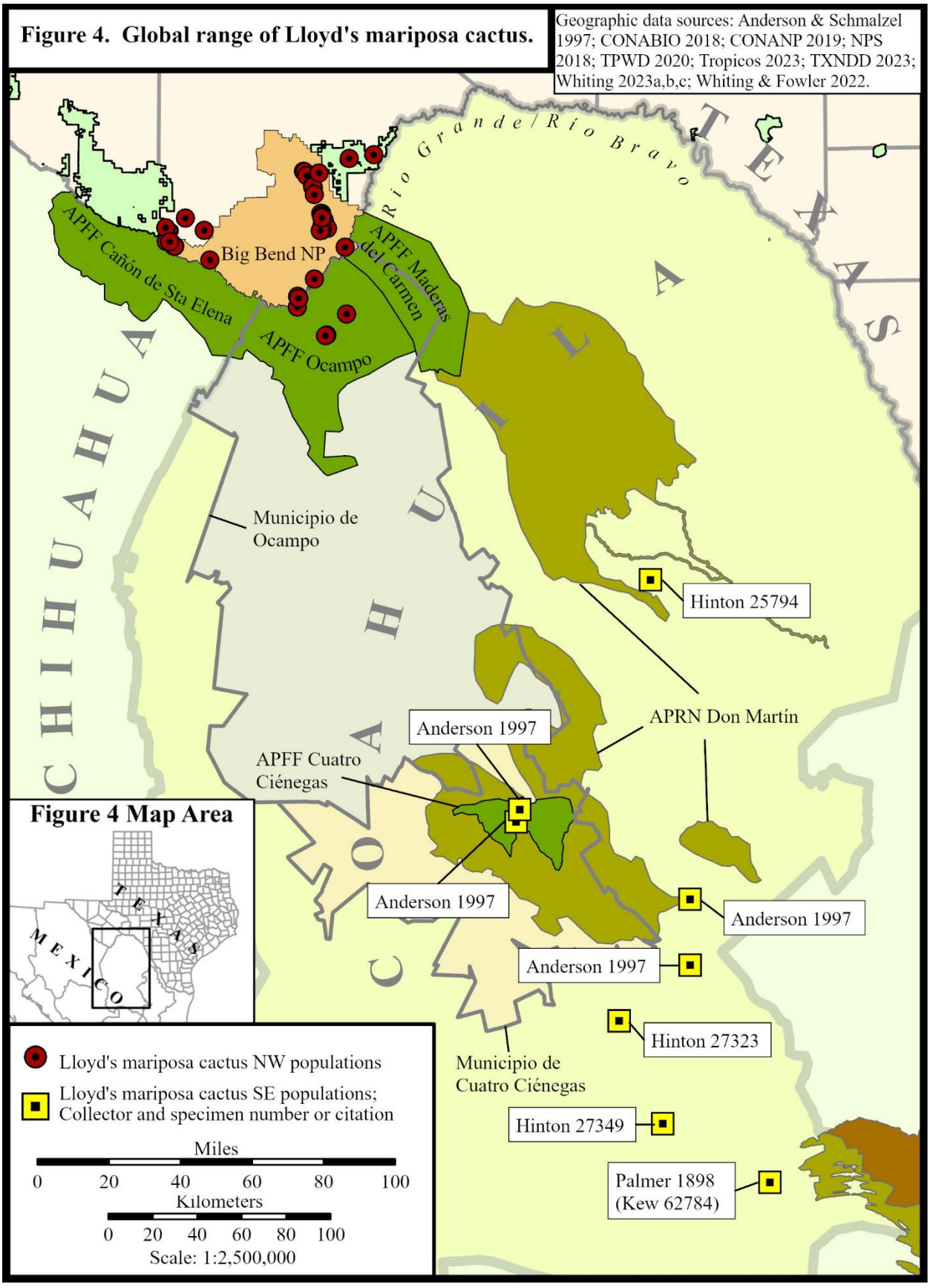
The National Park Service (NPS) Southwest Border Resource Protection Program provided a grant to Rio Bravo Restoration, a non-profit organization based in Terlingua, Texas, in collaboration with BIBE and Comisión Nacional de Areas Naturales Protegidas (CONANP (National Commission on Protected Natural Areas)), a Mexican federal agency. A main objective of this project is to conduct surveys for bunched cory cactus (*Coryphantha ramillosa* ssp. *ramillosa*), another ESA-listed threatened species, at the 344,238-ha (850,613-ac) Area de Protección de Flora y Fauna (APFF) Ocampo. This protected natural area in Coahuila, across the Rio Grande/Río Bravo from BIBE, is administered by CONANP. The surveyors found Lloyd's mariposa cactus in three locations at APFF Ocampo. The substrate was shaly limestone of the Boquillas/Ojinaga formation; bunched cory cactus was also observed at these sites (Whiting 2023c, p. 1 plus attachments). These previously undocumented population sites are shown in Figures 3 and 4.

Martínez-Avalos *et al*. (2020, p. 68) list *Echinomastus mariposensis* (Syn. *Sclerocactus mariposensis*) among the cactus species with the most restricted distribution in the Cuatro Ciénegas Basin of Coahuila. Flores Vazquez *et al*. (2020, p. 122) state that *E. mariposensis* occupies *bajadas* (slopes) at Cuatro Ciénegas, where it has a relative density of 0.52, a relative cover of 0.04, and an importance value of 0.28; these values confirm the conclusion of Martinez-Avalos *et al*. (2020, p. 68) that this is a rare species at Cuatro Ciénegas. Ochoterena *et al*. (2020, p. 156) include *Sclerocactus mariposensis* among the plant species that occur on gypsum soils at Cuatro Ciénegas.

Figure 4 shows the global distribution of Lloyd's mariposa cactus. We represent the strictly delimited populations of *S. mariposensis* with red bull's-eyes and the central Coahuilan populations with yellow squares.

Figure 4. Global range of Lloyd's mariposa cactus.

Geographic data sources: Anderson & Schmalzel 1997; CONABIO 2018; CONANP 2019; NPS 2018; TPWD 2020; Tropicos 2023; TXNDD 2023; Whiting 2023a,b,c; Whiting & Fowler 2022.



2.2.1.6 Habitat or ecosystem conditions (e.g., amount, distribution, and suitability of the habitat or ecosystem):

Whiting and Fowler (2022, pp. 27-28) defined their sampling universe, which is essentially a potential habitat model, to estimate the population of Lloyd's mariposa cactus at BIBE (discussed in Section 2.2.1.2). This sampling universe was similar to the potential habitat model we presented in USFWS 2018 but was restricted to BIBE, totaling 60,119 ha (148,555 ac; the column labeled "Whiting and Fowler 2022" in Table 1; Figure 3).

Whiting and Fowler (2022, pp. 25–58 and attached spreadsheets) documented 292 new individuals, many of which were previously undocumented. Based on this new data on soils and elevation range, in this review we revise our prior potential habitat model and expand it into Terrell County. This revised model identifies a total of 557,552 ha (1,377,712 ac) of potential habitat in Presidio, Brewster, and Terrell counties in Texas (the column labeled "USFWS 2025a" in Table 1; Figure 3).

Occupied soil types allow habitat modeling at a relatively precise scale. Digitized soil maps for most of the U.S. are available through the Web Soil Survey (NRCS 2024, entire). Unfortunately, the criteria for defining soil map units in the Web Soil Survey, and the symbols used to represent map units, vary from one county to the next. Consequently, to create habitat models that cover multiple counties, it is necessary to identify equivalent soil map units in each county. This challenge is compounded for species like Lloyd's mariposa cactus, whose habitats occur both in the U.S. and in Mexico (where available soil maps also use different mapping criteria). Because surface geology greatly influences soil types, digitized maps of surface geology are also very useful for modeling plant distribution. Although the polygons of available surface geology maps are usually larger, and therefore less precise than soil maps, geological strata are defined more consistently across county, state, and international borders. We developed an alternative potential habitat model based on the elevation range and the geological strata occupied by documented populations of Lloyd's mariposa cactus. This model identifies 815,575 ha (2,015,286 ac) of potential habitat in Texas and in northern Chihuahua and Coahuila, Mexico (USFWS 2025b in Table 1; Figure 3). Although Lloyd's mariposa cactus has not been recorded from Big Bend Ranch State Park (BBRSP), the soil- and geology-based potential habitat maps identify potential habitats within the southeastern portion of the park; consequently, TPWD plans to conduct surveys there (Strong 2024, entire).

2.2.1.7 Other:

No new information.

2.2.1.8 Conservation Measures:

Whiting and Fowler (2022, pp. 30, 32–33, Table 2.1 on p. 38) used extensive transect data to extrapolate the total population of Lloyd's mariposa cactus at BIBE and to improve habitat modeling criteria (discussed in detail in Section 2.2.1.2). The numbers of

individuals within transects yield an extrapolated population of over one million within potential habitats at BIBE. Even if limited to the areas within 200 m (656 ft) of the transects, the extrapolated population of nearly 15,000 individuals is distributed in five or more metapopulations and is seven to 10 times greater than the estimated MVP.

Whiting (2023c, p. 1 and attachments) documented Lloyd's mariposa cactus at three previously unknown sites within the APFF Ocampo protected natural area in Coahuila, Mexico.

2.2.2 Five-Factor Analysis (threats, conservation measures, and regulatory mechanisms):

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

Residential and commercial development and off-road vehicle (ORV) use continue to threaten populations and habitats in the small portion of the species' range on privately owned land in the Terlingua-Lajitas-Study Butte area of southwestern Brewster County. We estimate that about 8 percent of the species' potential habitats in Texas and northern Coahuila are on private lands in southwestern Brewster County where development is more likely to occur. Nevertheless, the total amount of the species' potential habitat in Texas and northern Coahuila that has been developed is very small (much less than 1 percent), and the current pace of development is relatively slow. Large amounts of potential habitats are protected at BIBE, BGWMA, BBRSP, APFF Santa Elena, APFF Ocampo, and APFF Cuatro Ciénegas. Therefore, we conclude that development and off-road vehicle use are current threats of very low magnitude and scope.

We expect that future trends in residential and commercial development and off-road vehicle use will be closely correlated with human population growth. The Texas Demographic Center (2022a) currently projects human population growth at the state and county level through 2060. Hence, the 2024 to 2060 time frame is a relevant period for projecting these threats. In 2022, the combined human population of Terlingua and Study Butte was 332 (8.1 people per km^2 (21.0 people per mi^2)) (U.S. Census Bureau 2022a, b). In 2020, the total population of Brewster County was 9,546 (0.6 people per km^2 (1.5 people per mi^2)) and is projected to decline 8 percent by 2060 (Texas Demographic Center 2022b). Therefore, we project that the current low rate of development in Brewster County will decrease even further over the next 36 years.

The species' known habitats in the Municipio de Ocampo, in northern Coahuila, are protected within APFF Ocampo. The Municipio de Ocampo encompasses remote expanses of mountains and deserts with sparse human populations; this municipio lies within the Bolsón de Mapimí, an endorheic basin from which no rivers flow to the sea. In 2020, the human population of the Municipio de Ocampo was 9,642 (0.4 people per km^2 (0.9 people per mi^2)), a decline of 12.3 percent since 2010 (Data México 2024a). The best documented populations of Lloyd's mariposa cactus in central Coahuila are protected within the 84,347-ha (208,421-ac) APFF Cuatro Ciénegas, which occupies about 11

percent of the area of the Municipio de Cuatro Ciénegas. In 2020, the human population of the Municipio de Cuatro Ciénegas was 12,715 (1.6 people per km^2 (4.2 people per mi^2)), a decline of 2.29 percent since 2010 (Data México 2024b). The remaining records of Lloyd's mariposa cactus in central and southern Coahuila are from herbarium specimens or observations by qualified experts, but these records do not include information about plant population sizes, local habitats, or land uses. Nevertheless, these data points occur in similarly desolate areas of the Chihuahuan Desert where habitats are largely intact and human populations are low and unlikely to grow. In summary, we conclude that the destruction and modification of the species' habitats caused by residential and commercial development and off-road vehicles is not likely to increase over the next 36 years to such an extent that the species' status would substantially decline.

As stated in the previous 5-year review (USFWS 2018, pp. 22–23, 26), livestock grazing is a threat of low magnitude to the relatively small portion of the species' range that is actively used as rangeland.

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

Lloyd's mariposa cactus is eagerly sought by cactus collectors in many countries. In 2025 we conducted an internet search of commercial cactus nurseries but found no recent Western Hemisphere vendors of Lloyd's mariposa cactus live plants or seeds. One vendor in Sweden offers seeds of Lloyd's mariposa and other U.S.-listed cactus species, but states that these species are protected by the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), and the seeds can only be shipped within the European Union (https://www.succseed.com/en/seeds-cacti/echinomastus/echinomastus-mariposensis-ocampo-coahuila-mex.html). It is likely that seeds openly offered for sale were produced from plants grown ex-situ, originating from plants or seeds that were legally collected prior to the species' listing. We do not have information regarding the current extent of illegal collection of seeds or live plants from the wild. Some documented, highly accessible populations, such as along highway rights-of-way (ROWs), were depleted by illicit collection in the past. Nevertheless, we have received no recent reports of illicit collection from protected, monitored populations, such as at BIBE and BGWMA. Considering the large size of populations on three protected natural areas, the large size and remoteness of private properties where the species occurs, and the strict enforcement of trespass laws in Texas, we conclude that illicit collection is an ongoing threat of low magnitude. Based on the projected human population decline in Brewster County (discussed above), and the relative ease of growing Lloyd's mariposa cactus from seeds of plants already in cultivation compared to collecting from the wild, we do not anticipate a significant increase in illicit collection through 2060.

2.2.2.3 Disease or predation:

No new information.

2.2.2.4 Inadequacy of existing regulatory mechanisms:

Ordinarily, the ESA would confer a greater degree of protection to Lloyd's mariposa cactus populations on federal land, at BIBE, than to populations on private land. However, as discussed in the previous 5-year review (USFWS 2018, pp. 23–26), the Real ID Act of 2005 grants authority to the Department of Homeland Security (DHS) to waive the provisions of the ESA and other federal laws for border security infrastructure and operations. All known U.S. populations, including those inside BIBE, are within about 30 km (18.6 mi) of the border and could be affected by the future construction of border barriers, roads, or surveillance towers, should such activities occur within the vicinity of these individuals. Currently, we are not aware of any border security projects that may affect Lloyd's mariposa cactus populations. At this time, we cannot project how border security policies may change in the future or whether such activities would be located in areas where the species occurs. Therefore, we conclude that border security infrastructure and operations present a potential threat of unknown magnitude and immediacy to populations on the U.S. side of the border with Mexico. Mexican populations of Lloyd's mariposa cactus are protected (as *Echinomastus mariposensis*) as a threatened species (category A) by the Mexican federal government (Secretaría de Medio Ambiente y Recursos Naturales 2010, p. 56).

2.2.2.5 Other natural or manmade factors affecting its continued existence:

The listing rule (44 FR 64249) concluded that low total population levels intensify the adverse effects of threats to Lloyd's mariposa cactus and its habitats. Small populations are more vulnerable to extirpation during extreme weather events, such as prolonged drought. The genetic consequences of small population sizes include the loss of genetic variation, increased inbreeding, and genetic drift. Although the breeding system of Lloyd's mariposa cactus has not been investigated, among members of the Cactus family that have been studied, 59 percent are self-incompatible and 62 percent have an outcrossing mating system (Mandujano *et al*. 2010, pp. 205–211). Furthermore, the average level of population inbreeding depression in the family is 0.82 ± 0.26; this relatively high level underscores the importance of outcrossing among cactus species (Mandujano *et al*. 2010, p. 219). Hence, the genetic consequences of small population sizes are further compounded for outcrossing, self-incompatible cactus species that incur inbreeding depression, due to reductions in seed production, fitness, and recruitment.

Nevertheless, in addition to the qualitative reports of several observers that Lloyd's mariposa cactus is much more abundant than formerly known, the quantitative census of Whiting and Fowler (2022, pp. 30, 32–33, Table 2.1 on p. 38) clearly demonstrates that a number of large, highly viable populations are protected at BIBE. Therefore, we conclude that small population sizes and their consequences, such as demographic vulnerability, loss of genetic variation, inbreeding, and genetic drift, are no longer direct threats to the species, nor do they intensify other threats. We do not anticipate these factors to become threats to Lloyd's mariposa cactus during the next three to four decades.

In the previous 5-year review, we reviewed climate projections from the Fifth Assessment Report for the Intergovernmental Panel on Climate Change (IPCC 2013), and considered how these changes will affect the status of Lloyd's mariposa cactus in the future. The projections from the more recent Sixth Assessment Report (IPCC 2021) that are relevant to the continued survival of Lloyd's mariposa cactus include:

- Global surface temperature will continue to increase until at least the mid-century under all emissions scenarios considered. Global warming of 1.5° C and 2° C will be exceeded during the 21st century unless deep reductions in CO^2 and other greenhouse gas emissions occur in the coming decades.

- Many changes in the climate system become larger in direct relation to increasing global warming. They include increases in the frequency and intensity of hot extremes, marine heatwaves, and heavy precipitation, agricultural and ecological droughts in some regions, and proportion of intense tropical cyclones, as well as reductions in Arctic sea ice, snow cover and permafrost.

- Continued global warming is projected to further intensify the global water cycle, including its variability, global monsoon precipitation and the severity of wet and dry events.

The U.S. Global Climate Research Program (USGCRP) Fourth National Climate Assessment (USGCRP 2017) reports that average annual temperatures from 1986—2016 have increased in the Southern Great Plains (including the geographic range of Lloyd's mariposa cactus) by 0.42° C (0.76° F), compared to 1901—1960 (USGCRP 2017, Chapter 6, Table 6.1). Average annual temperatures in the Southern Great Plains are projected to increase by 2.65° to 4.69° C (4.78° to 8.44° F), under moderate and high emission scenarios, respectively, by the late 21st century (USGCRP 2017 Chapter 6, Table 6.4). Projected precipitation changes under the highest emissions scenario, by the end of the 21st century, will be smaller than natural variations over the Southern Great Plains (USGCRP 2017 Chapter 7 pp. 15–16 and Figure 7.5). However, the frequency of heavy precipitation events has increased from 1901 to 2016 and 1948 to 2016 (USGCRP 2017 Chapter 7 pp. 5–9 and Figures 7.2–7.4) and is projected to continue to increase under moderate and high emission scenarios (USGCRP 2017 Chapter 7 pp. 18–24 and Figures 7.6–7.8).

These revised projections are not substantively different from the IPCC 2013 projections. Currently available information does not indicate how prior climate changes affected the species' fitness and survival, nor how projected climate changes will affect the species' viability. The projected climate changes may have multiple affects, both positive and negative. The currently available information does not indicate that there will be a net change to the species' viability in the future.

Table 2. Factors affecting the survival of Lloyd's mariposa cactus.

ESA Listing Factor	44 FR 64247 and 1990 Recovery Plan	2025 5-year status review
A	Mercury mining had ceased and is no longer considered a threat. ORV use remains a potential threat. Livestock grazing is a potential threat in some areas.	The total amount of the species' potential habitat that has been developed is very small (much less than 1 percent), and the current pace of development is relatively slow; development and off-road vehicle use are ongoing threats of low magnitude that affect a small portion of the range. We project that the current low rate of development will decrease over the next 36 years. Livestock grazing is an ongoing threat of low magnitude that affects a small portion of the range.
B	Collection from the wild depleted many known populations, and the threat to remaining populations may increase as a consequence of development.	Illicit collection from the wild has not been recently reported; large cactus populations occur on three protected natural areas; populations also occur on large, remote private properties in Texas that are protected by trespass laws; we conclude that illicit collection is an ongoing threat of low magnitude. We do not anticipate a significant increase in illicit collection through 2060.
C	Current livestock grazing had not affected the species, but increased grazing and some range management practices potentially threaten populations.	Livestock grazing is a threat of low magnitude to the relatively small portion of the species' range that is actively used as rangeland. Mortality from herbivory may increase during drought. This threat may become more severe if the incidence of drought increases. The extent of mortality from parasites is unknown.
D	NPS regulations prohibit taking of natural resources—including Lloyd's mariposa cactus— from the park. Listed in Appendix I of CITES, but this applies only to international trade.	Endangered Species Act provisions can be waived by DHS for construction of border security infrastructure and operations, presenting a potential threat of unknown magnitude and immediacy to populations on the U.S. side of the border with Mexico if such activities were to occur within the vicinity of the species' populations; there are no current

		plans for border construction in areas where the cactus occurs.
E	Small population sizes intensify adverse effects of other threats.	Qualitative observations indicate that a number of large populations occur at BGWMA and private properties in Texas, and populations have now been documented at 3 sites in APFF Ocampo, Coahuila. Quantitative censuses confirm that multiple viable populations are protected at BIBE with an estimated total of over 1 million individuals. The demographic and genetic consequences of small population sizes no longer threaten the species directly nor intensify other threats. We do not anticipate these factors to become threats to Lloyd's mariposa cactus during the next three to four decades. Climate changes may have multiple effects on fitness and survival; however, currently available information does not indicate that there will be a net change to the species' viability in the future.

2.3 Synthesis

Lloyd's mariposa cactus is consistently recognized as a valid species of either *Echinomastus* or *Sclerocactus* (both are currently considered valid alternative names). However, a recently published phylogenetic analysis indicates that *Echinomastus* is paraphyletic; consequently, we recognize *Sclerocactus mariposensis* as the correct taxonomic classification.

The known populations of Lloyd's mariposa cactus occur on formations of highly fractured limestone at elevations ranging from 650-1,150 m (2,132-3,773 ft). We provisionally estimate that about 815,575 ha (2,015,286 ac) of potential habitat occur in Presidio, Brewster and Terrell Counties, Texas, and in northern Coahuila and Chihuahua, Mexico (this does not include the populations in central and southern Coahuila). Recent survey results indicate that the species is much more abundant than previously known, with large populations at BIBE, BGWMA, and on private land in Texas. Quantitative census data collected from well-dispersed transects confirms at least five viable meta-populations occur at BIBE; the total extrapolated population in BIBE may exceed 1,000,000 individuals. Three populations have now also been documented at APFF Ocampo in Coahuila.

The threats from habitat development, ORV use, livestock grazing, and illicit collection are all of small geographic scale and/or low magnitude across the range in both the U.S. and Mexico. We do not anticipate that these threats will increase significantly during the next 36 years (through 2060). The threats from browsing and parasitism remain unknown; these are natural density-dependent factors that influence population fluctuations. Border security infrastructure and operations present a potential threat of unknown magnitude and immediacy to populations on the U.S. side of the Mexican border. Climate changes may have multiple effects on fitness and survival; however, we do not have information to project the net change to the species' viability.

In central and southern Coahuila, we have limited information regarding population sizes and distribution. However, herbarium records indicate that individuals were found in multiple locations throughout the region in the mid- to late-1990s. The best documented populations of Lloyd's mariposa cactus in central Coahuila are protected within the 84,347-ha (208,421-ac) APFF Cuatro Ciénegas, which occupies about 11 percent of the area of the Municipio de Cuatro Ciénegas. Herbarium records from southeastern Mexico occur in similarly desolate areas of the Chihuahuan Desert, where habitats are largely intact and human populations are low and unlikely to grow. We do not have information regarding the current extent of illegal collection of seeds or live plants from the wild; however, we do not anticipate a significant increase in illicit collection. Climate changes may have multiple effects on fitness and survival; however, currently available information does not indicate that there will be a net change to the species' viability in the future across its range. We have no indication that the southeastern Mexico populations are affected by threats differently or at a higher level than those in the Big Bend region.

In summary, the cumulative effects of the known threats to Lloyd's mariposa cactus are relatively small compared to the number, large size, and viability of known populations.

The Recovery Plan (USFWS 1990, pp. iii, 13–14) lists the following recovery criteria:

- Three populations with at least 1,000 individuals each should occur on sites where the species can be protected and managed; one site should be on private land in northeastern Brewster County, one site should be in BIBE, and one site should be in Mexico.
- Each site should have enough available habitat to permit population expansion and growth.
- The species can be delisted when monitoring and habitat surveys indicate that a total of at least 20,000 plants is sustained at the protected and managed sites.

At least five populations averaging nearly 3,000 individuals each occur at BIBE. Large, viable populations are also protected at BGWMA, and 15 populations of unknown size occur on private land across southern Brewster County. Additional populations of unknown size are protected at APFF Ocampo and APFF Cuatro Ciénegas in Coahuila. The total population at BIBE alone may exceed 1,000,000 individuals. Even if the populations in central and southern Coahuila represent a distinct taxon, the populations in the Big Bend region of Trans-Pecos Texas and northern Coahuila and Chihuahua exceed all of the established recovery criteria and are projected to experience minimal future threats. Although Lloyd's mariposa cactus is a rare, endemic species of the Chihuahuan Desert of Texas and Mexico, and will remain a species of conservation concern, both qualitative observations and quantitative censuses confirm that the species has redundant, resilient populations that occur in a larger geographic and ecological range than previously known.

Without the protections of the ESA, U.S. populations of Lloyd's mariposa cactus would still be protected by the National Park Service at BIBE and by TPWD at BGWMA. The ESA does not protect U.S. populations on private lands from residential and commercial development or off-road vehicles unless there is a federal nexus or a violation of state law; we expect that such protections would rarely apply to actions that affect populations on private lands in the U.S. regardless of ESA protections. Hence, the removal of ESA protections would increase threats to a very small proportion of the U.S. populations that are not within BIBE or BGWMA. The Mexican populations are protected as a threatened species under the Mexican federal at-risk species law (NOM-059-SEMARNAT-2010), and the species has additional protections at APFF Ocampo and at APFF Cuatro Ciénegas. CITES prohibits the international trade of this species in both the U.S. and Mexico. In summary, the removal of ESA protections may result in increased threats to the U.S. populations of Lloyd's mariposa cactus that occur on private lands, but these threats are small compared to the large numbers and sizes of populations.

We conclude that Lloyd's mariposa cactus does not meet ESA definitions' of a threatened or endangered species, and therefore recommend the species be delisted due to recovery.

3.0 RESULTS

3.1 Recommended Classification:

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

- The species does not meet the definition of an endangered species or a threatened species (i.e., is recovered, or new information on status and threats indicate species does not meet definitions)

Lloyd's mariposa cactus has redundant large, viable populations that are protected at BIBE and BGWMA. Outside these protected areas, 15 EOs have been found on private lands where relatively little development is expected to occur. Populations of unknown size have also been discovered at two protected natural areas in Coahuila, APFF Ocampo and APFF Cuatro Ciénegas. Therefore, although the species is endemic to the Big Bend region of Texas and Coahuila, the cumulative effects of the known threats to Lloyd's mariposa cactus are small compared to the number, large size, and viability of known populations.

3.2 New Recovery Priority Number (indicate if no change; see 48 FR 43098):

No change is needed.

3.3 Listing and Reclassification Priority Number if reclassification is recommended (see 48 FR 43098):

Delisting (Removal from list regardless of current classification) Priority Number: 4

Brief Rationale:

The cumulative effects of the known threats to Lloyd's mariposa cactus are relatively small compared to the number, large size, and viability of known populations. The recovery potential is high, as the species has large populations on three large, protected conservation lands in Texas and in northern Coahuila; additional populations occur on large private ranches where there is relatively little potential for large-scale development. Lloyd's mariposa cactus is consistently recognized by systematic botanists as a full species.

4.0 RECOMMENDATIONS FOR FUTURE ACTIONS

- Explore the potential for long-term conservation of Lloyd's mariposa cactus populations on private lands in Presidio, Brewster, and Terrell counties, Texas through private landowner agreements or other appropriate measures.
- Continue to conduct quantitative population size estimates on additional, accessible populations using unbiased, representative samples and appropriate statistical analyses.
- Continue to improve potential habitat models as we learn more about the species' ecological requirements.
- Investigate the species' population genetics to determine the structure, diversity, extent of inbreeding, evidence of gene flow, and other parameters that will be useful in the continued conservation of Lloyd's mariposa cactus.
- Investigate the phylogenetic relationship between the populations described as *Sclerocactus mariposensis* in central and southern Coahuila and populations in the Big Bend region.
- Pursue cooperative efforts with Mexican agencies, non-profit conservation organizations, and academic institutions to promote their conservation and management.
- If the species is delisted, the threat of illicit collection may increase. Work with commercial cactus nurseries and private collectors to develop protocols to discourage digging live plants from the wild (unless conducted to salvage plants that would otherwise be imminently destroyed), and to follow Center for Plant Conservation guidelines for collecting seeds from wild plants.

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6.0 ADDITIONAL INFORMATION

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Figure 1.4: Carolyn Whiting, NPS.

Abbreviations:

APFF	Area de Protección de Flora y Fauna
BGWMA	Black Gap Wildlife Management Area
BIBE	Big Bend National Park
BBRSP	Big Bend Ranch State Park
C.F.R.	Code of Federal Regulations
CONABIO	Comisión Nacional para el Conocimiento y Uso de la Biodiversidad
CONANP	Comisión Nacional de Areas Naturales Protegidas
DEM	Digital Elevation Model
DHS	Department of Homeland Security
EO	Element Occurrence
ESA	Endangered Species Act
FR	Federal Register
INEGI	Instituto Nacional de Estadística y Geografía
MVP	Minimum viable population
NPS	National Park Service
NRCS	Natural Resources Conservation Service
ORV	Off-road vehicle
SGM	Servicio Geológico Mexicano
TNRIS	Texas Natural Resource Information Service
TPWD	Texas Parks and Wildlife Department
TXNDD	Texas Natural Diversity Database
U.S.C.	United States Code
USFWS	U.S. Fish and Wildlife Service

Scientific units:

ac	acre	km	kilometer
ft	feet	m	meter
ha	hectare	mi	mile
in	inch	mm	millimeter

Glossary of Scientific and Technical Terms.

Term	Definition
Breeding System	The method by which a plant can successfully produce seeds. Plants have three basic breeding systems: outbreeding or outcrossing, where pollen from a different individual is needed to fertilize the egg of the maternal plant to produce seeds successfully; selfing or self-fertilization, where pollen from the same individual can fertilize the egg and produce seeds; or apomixis, where seeds can be set without fusion of gametes (Center for Plant Conservation 2019, p. G-2).
Chloroplast	A double-membrane organelle found in higher plants in which photosynthesis takes place.
Confidence interval	"A statistical range with a specified probability that a given parameter lies within the range." (Houghton Mifflin Company 1982).
Congener	Members of the same genus.
Demography	Scientific study of populations.
Element Occurrence	An area of land and/or water in which a species or natural community is, or was, present (NatureServe 2002).
Endemic	An organism restricted to a specific habitat or geographic range.
Endorheic Basin	A watershed that lacks surface or subsurface drainage into external rivers, lakes, or oceans.
Ex-situ	Off site (as opposed to *in situ*). Usually a controlled environment, such as a botanical garden, arboretum, or laboratory.
Gene flow	The movement of individuals and/or alleles from one population of a taxon to another (adapted from Center for Plant Conservation 2019, p. G-5); gene flow among terrestrial plants occurs mainly through pollination, seed dispersal, or the dispersal of vegetative propagules by wind, water, or animal vectors.
Genetic drift	Random changes in allele frequencies as well as complete loss of alleles from the gene pool of a population.
Genetic structure	A measure of the genetic differences across and within populations of a species (Center for Plant Conservation 2019, p. G-5).
Importance value	The sum of the relative density, relative dominance, and relative frequency of a species in a community.
Inbreeding	Sexual reproduction between closely related individuals.
Inbreeding depression	The reduction of fitness caused by mating between relatives (Edmands 2007, p. 464).
Metapopulation	Geographically separate groups of individuals (sub-populations) of a taxon that collectively function as a population through some degree of gene flow. Examples include formerly contiguous populations that have become fragmented, populations whose progeny have established outlying groups,

	and populations that have divided and migrated in separate directions but are not yet completely isolated.
Minimum viable population	The fewest individuals required for a specified probability of survival over a specified period of time (Pavlik 1996; Mace and Lande 1991).
Monophyly	A group of organisms that consists of all the descendants of a single common ancestor.
Outcross	In plants, sexual fertilization involving the union of gametes from different individuals.
Paraphyly	A group of organisms which consists of some, but not all of the descendants of a common ancestor.
Phylogeny	The evolutionary history of a taxon (Diggs et al. 1999, p. 1446). Modern phylogenetic studies use statistical analyses of differences in gene sequences between groups of organisms and estimated rates of mutation.
Potential habitat model	A model of a species' potential geographic distribution based on the distribution of known habitat characteristics, such as geology, soils, elevation, hydrology, slope, aspect, and annual temperature and rainfall patterns.
Recovery criteria	The demographic parameters and threat conditions that, when combined, comprise the standards upon which the decision to consider whether to reclassify or delist a species should be based (National Marine Fisheries Service and U.S. Fish and Wildlife Service 2019).
Relative cover	The cover of an individual species divided by the cover of all species in a specified area.
Relative density	The density of an individual species divided by the density of all species in a specified area.
Self-incompatible	Incapable of self-fertilization (sexual reproduction involving the union of gametes from a single individual).
Systematics	Scientific study of the kinds and diversity of living organisms and of the relationships between them; often used synonymously with taxonomy (Diggs et al. 1999, p. 1452).
Taxon	(Plural, taxa). A natural group of organisms at any rank in the taxonomic hierarchy (Anderson 2001).
Transect	An ecological sample unit of relatively narrow width and much greater length conducted in a specified direction.

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U.S. FISH AND WILDLIFE SERVICE

5-YEAR REVIEW OF LLOYD'S MARIPOSA CACTUS

Current Classification: Threatened

Recommendation resulting from the 5-Year Review:

Delist, due to recovery.

REGIONAL OFFICE APPROVAL:

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

Approve SETH WILLEY Digitally signed by SETH WILLEY Date: 2025.07.23 09:59:25 -06'00' _____