

Interim Core Map Documentation for Lee Pincushion Cactus (*Coryphantha sneedii* var. *leei*)

Version 1

Review Completed: April 2026

Core Map Developer: U.S. Environmental Protection Agency (EPA) Office of Pesticide Programs (OPP)

Species Summary

The Lee pincushion cactus (*Coryphantha sneedii* var. *leei*; Entity ID #682) is a threatened terrestrial plant (dicot). The U.S. Fish and Wildlife Service (FWS) has not designated a critical habitat for the Lee pincushion cactus. This species is typically found growing in semi-desert grasslands. The Lee pincushion cactus appears to rely on limestone formations for survival and is known to occur on ledges and cracks on vertical cliffs and ledges. Pollination for this species is essential for growth; no evidence of flowers without pollen has been seen. Currently, the Lee pincushion cactus is found in 15 canyons: one core Lee's population (consisting of the Serpentine Bends/Dark Canyon/Crooked Creek, Walnut Canyon, Rattlesnake Canyon, North Slaughter Canyon/Middle Slaughter Canyon, Bear Canyon, Midnight Canyon, Putnam Canyon, West Slaughter Canyon, and Yucca Canyon occurrences) and one core Sneed's-form population (consisting of the Lefthook Canyon, Double Canyon, Cottonwood Canyon, Gunsight Canyon, and Big Canyon occurrences), as well as a third, isolated, Lee's individual (Sargent Canyon) in Carlsbad, NM. Additional information on the species is provided in **Appendix 1**.

Description of Core Map

The core map for the Lee pincushion cactus is on the range with habitat refinements. Since this species only occurs on limestone and in desert areas, the core map was refined by only including areas where geology featured limestone and Lincoln National Forest, Carlsbad National Park, and Guadalupe Mountain National Park lands to encompass known locations. Lastly, forested areas were removed from the core map since this species does not occur in forested areas.

Figure 1 depicts the results interim core map for the Lee pincushion cactus. The size of the core map is approximately 754,091 acres. Landcover categories within the core map area are included in **Table 1**. Land cover is almost exclusively scrub/shrub and grassland/herbaceous, which aligns with the species habitat.

The core map developed for the Lee pincushion cactus is considered interim. This core map will be used to develop pesticide use limitation areas (PULAs) that include the Lee pincushion cactus. This core map incorporates information developed by FWS and made available to the public; however, the core map has not been formally reviewed by FWS. This interim core map may be revised in the future to incorporate expert feedback from FWS. This interim core map has an "average" (3) best professional classification to describe major uncertainties/limitations. The map is based on range with refinements of

habitat described by FWS. This core map does not replace or revise any range or designated critical habitat developed by FWS for this species.

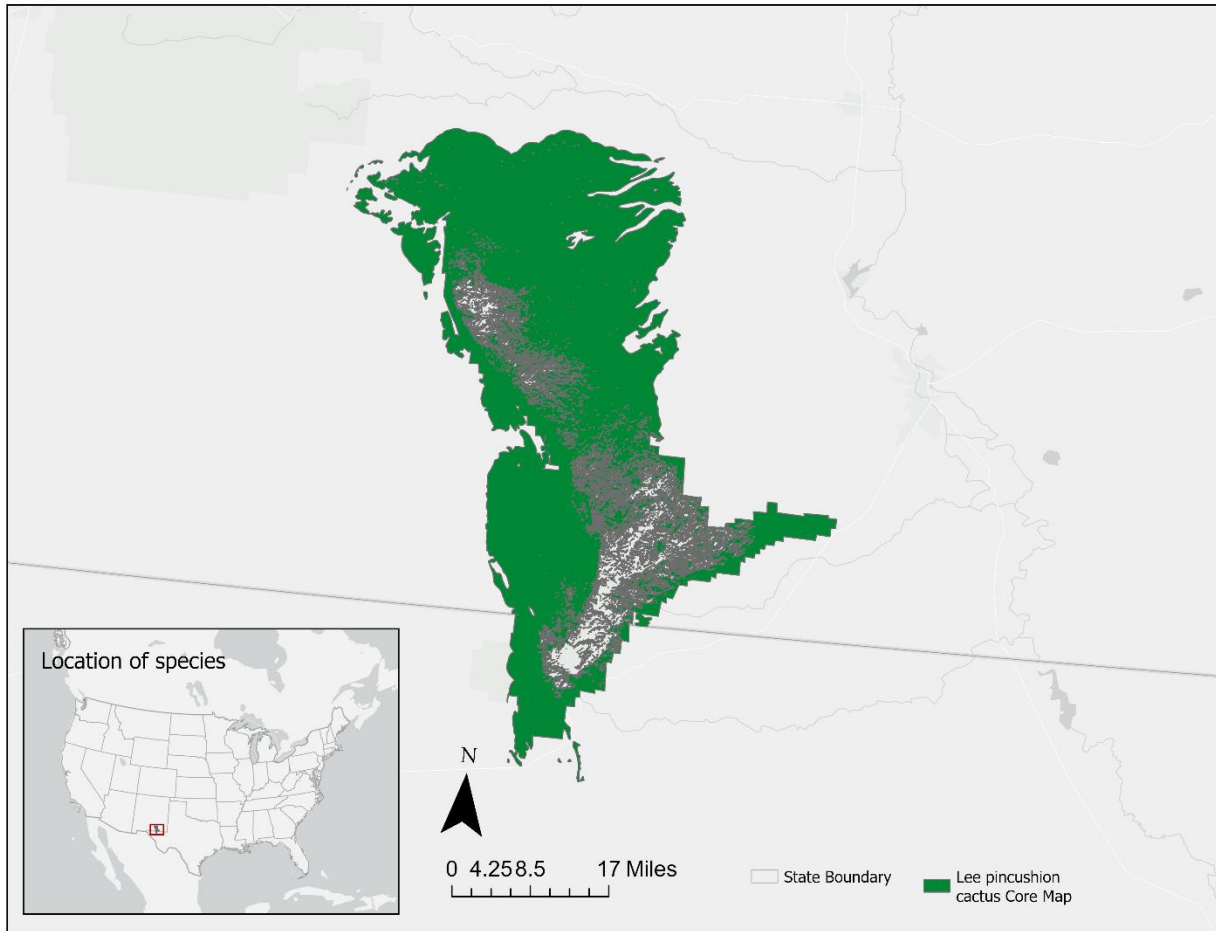


Figure 1. Interim core map for the Lee pincushion cactus. The total acreage of the interim core map is approximately 754,091 acres.

Table 1. Percentage of Interim Core Map Represented by National Land Cover Database (NLCD) Land Covers and Associated Example Pesticide Use Sites/Types.

Example pesticide use sites/types	NLCD Landcover (Value)	% of core map represented by landcover
Forestry	Deciduous Forest (41)	0
Forestry	Evergreen Forest (42)	0
Forestry	Mixed Forest (43)	0
Agriculture	Pasture/Hay (81)	<1
Agriculture	Cultivated Crops (82)	0
Mosquito adulticide, residential	Open space, developed (21)	0

Example pesticide use sites/types	NLCD Landcover (Value)	% of core map represented by landcover
Mosquito adulticide, residential	Developed, Low intensity (22)	<1
Mosquito adulticide, residential	Developed, Medium intensity (23)	<1
Mosquito adulticide, residential	Developed, High intensity (24)	<1
Invasive species control	Woody Wetlands (90)	0
Invasive species control	Emergent Herbaceous Wetlands (95)	0
Invasive species control	Open water (11)	0
Invasive species control	Grassland/herbaceous (71)	~10
Invasive species control	Scrub/shrub (52)	~90
Invasive species control	Barren land (rock/sand/clay; 31)	<1
Total Acres	Interim Core Map Acres	~ 754,091

Evaluation of Known Location Information

There are four datasets with known location information for this species:

- Descriptions of locations provided by FWS
- Occurrence locations included iNaturalist
- Occurrence locations included in the Global Biodiversity Information Facility (GBIF)
- Occurrence locations included in NatureServe

EPA evaluated these sets of data to inform or support the core map. FWS appeared to have the finest resolution of the location information, providing a map that depicted the current known locations all within the 15 canyons near Carlsbad, NM (**Figure 2 in Appendix 1**). Occurrences in iNaturalist, GBIF, and NatureServe did not support expanding the core map outside of those 15 canyons. **Appendix 1** includes more information on the available known location information.

Approach Used to Create Core Map¹

The core map was developed using the “Process EPA Uses to Develop Core Maps for Draft Pesticide Use Limitation Areas for Species Listed by the U.S. Fish & Wildlife Service (FWS) and their Designated Critical Habitats³” (referred to as “the process”). This core map was developed by EPA using the 4 steps described in the process document:

1. Compile available information for a species
2. Identify core map type
3. Develop the core map for the species
4. Document the core map

For Step 1, EPA compiled available information for the Lee pincushion cactus from FWS, as well as observation information available from various publicly available sources (including iNaturalist, GBIF, and

¹ U.S. Fish and Wildlife Services Environmental Conservation Online System (ECOS)

NatureServe). The information compiled for the Lee pincushion cactus is included in Appendix 1. Influential information that impacted the development of the core map included:

- The species range was updated in 2025 and encompasses the described known locations.
- There are 15 known canyons where Lee's pincushion cactus occurs in FWS documentation, all of which are within the species' range.
- Species has specific habitat of limestone and in desert habitats.

For Step 2, EPA used the compiled information to identify the core map type. EPA compared known location data to the range and found that these known locations occur within the species range. Therefore, the outer extent of the core map was based on the range identified by FWS. The core map was refined by using geology features of limestone along with the fact that the species does not occur within forested habitat. The entire range of the species was not used as the core map because the range contains areas where the species does not occur.

For step 3, EPA used the best available data sources to generate the core map. Data sources are discussed in the process document. For this core map, EPA used the FWS range as the starting point¹. The range was further refined by using the State Geologic Map Compilation (SGMC) Geodatabase of the Conterminous United States to refine by limestone features². Lastly, National Land Cover Database (NLCD)^{Error! Bookmark not defined.} was used to remove forested habitat since this species does not occur in forested areas. **Appendix 2** provides more details on the GIS analysis and data used to generate the core map.

Discussion of Approaches and Data that were Considered but not Included in Core Map

EPA did not explore approaches other than those described in this documentation.

Appendix 1. Information Compiled for Species

1. Recent FWS Documents

- [Sneed/Lee Pincushion Cactus \(2 spp.\) Recovery Plan \(1986\)](#)
- [Amendment 1 - Sneed/Lee Pincushion Cactus Recovery Plan \(2019\)](#)
- [Lee Pincushion Cactus \(*Coryphantha sneedii* var. *leei*\) 5-Year Review \(2015\)](#)
- [Lee² Pincushion Cactus 5 Year Status Review \(2023\)](#)

2. Background Information on Species

- **Status:** Federally listed as threatened in 1979 (Recovery Plan, 1986)
- **Taxonomy:** A terrestrial plant belonging to the cactus family (*Cactaceae*)
 - Genus has synonyms that include *Escobaria sneedii* and *Pelecyphora sneedii*
- **Resiliency**
 - “Initial species abundance estimates were made in 1984–1985, so the current abundance of Lee’s populations are unknown. Trend data last collected in 1992–1995 documented that monitored recreation effects plots were stable to increasing. This historic information is unlikely to be a reliable estimate of current abundance and/or trends given the extended droughts of 2002–2004, 2011–2014, and 2020–2022. Trend data last collected in 2018 from fire effects monitoring plots documented that both monitored burned and unburned fire effects plots were declining. However, these were targeted plots, which are known to be biased toward detecting declining trends that may not represent actual population-level trends. Trends for most occurrence areas have never been monitored. Habitat suitability and availability may be decreasing with increasing temperatures (5-Year Review, 2023).”
- **Redundancy**
 - “No direct Lee’s relatively continuous known range (excluding the Sargent Canyon occurrence) extends approximately 30 km (19 mi) southwest to northeast approximately 15 km (9 mi) southwest to northeast (excluding that core population). This range is not extensive enough to ensure geographic independence of the two core population areas that constitute this range given the potential extent of regional extended droughts and other destructive, broad-scale severe weather events, which can span several states. However, this range is extensive enough to ensure that wildfires and vegetation treatments wouldn’t affect all occurrences simultaneously given that recent fires in comparable habitats ranged from 3–11 km (2–7 mi) in extent. Given the contiguity of occurrence areas and evidence of gene flow within this range, there’s potential for populations to rescue one another following more localized catastrophic events. There is also a single known disjunct individual (the Sargent Canyon occurrence) approximately 58 km (36 mi) northwest of the north-most Lee’s in the Serpentine Bends area. As a single individual, it’s unlikely to provide redundancy to Lee’s at the species level (5-Year Review, 2023).”
- **Representation**
 - “No Lee’s currently occupies 2–3, geographically isolated and genetically distinct representation areas, depending on phylogenetic analysis results: one core Lee’s population and one core Sneed’s-form population, as well as a third, isolated, Lee’s individual. Genetic diversity within and between occurrence areas and/or

² The State Geologic Map Compilation (SGMC) Geodatabase of the Conterminous United States August 18th, 2017.

populations is unknown, but there's evidence of gene flow between West Slaughter and Yucca Canyon, between Big and Cottonwood Canyon, and between these sets of canyons. However, based on small population size(s), we suspect that Sneed's is experiencing a loss of evolutionary potential from loss of diversity through genetic drift, except rough range-wide abundance estimate, which includes Sneed's-form occurrences. Therefore, while evolutionary processes appear functional, Lee's may have a compromised capacity to adapt to changing environmental conditions (5-Year Review, 2023)."

- **Habitat Description:**
 - The Sneed and Lee pincushion cactus grow in semi-desert grassland. The Lee pincushion cactus can be found on the Tansil Limestone Formation and grows on north-facing ledges, along with cracks on vertical cliffs or ledges (Recovery Plan, 1986).
 - The limestones are generally hard, resistant to erosion, and support a sparse vegetation of low shrubs, some rosette-forming perennials, many cacti, and both annual and perennial herbs (Recovery Plan, 1986).
 - The Lee pincushion cactus occupies steep, rugged, remote terrain (5-Year Review, 2023).
- **Pollinator/Reproduction (Recovery Plan, 1986):**
 - "Most Lee pincushion cacti bloom after 3-4 years. Plants bud in late March or early spring."
 - "No evidence of sterile plants, or flowers without pollen, has been seen, nor is there any evidence of hybridization."
 - "Plants are clustered in populations so a very high percentage of flowers are pollinated."
 - Most fruits are eaten by insects or by rodents who probably scatter a few seeds in the process. If a fruit is not eaten, which happens to a sizeable portion of them, weathering breaks down the fruit wall causing the seeds to be dispersed by wind and rain."
- **Relevant Pesticide Use Sites:**
 - Pesticide application was listed as a habitat threat (5-Year Review, 2023).
- **Threats:**
 - "Lee's 1986 recovery plan lists the construction, use, and maintenance of recreation attractant features (such as roads, trails, picnic areas, and campsites) and ungulate trampling as potential threats to habitat. In addition to these, fire suppression activities; range improvement construction, use and maintenance; pesticide applications; and potentially, decreases in air quality are documented habitat threats (5-Year Review, 2023).
- **Recovery Criteria/Objectives (5-Year Review, 2023):**
 - "Delisting Criteria 1: All core populations demonstrate stable or increasing trends in abundance over a 20-year period."
 - "Delisting Criteria 2a: Maintain a minimum of three geographically separated core populations for each species over a 20-year period."
 - "Delisting Criteria 2b: A minimum of one new core population will be discovered (use Criterion 1) or established outside the current range and wholly separated geographically from the other core populations and remain occupied for 10 years out of the 20-year survey period."

- “Delisting Criteria 3a: Maintain genetic diversity within all core populations as measured by the fixation indices inbreeding coefficient (F_{IS}) at or within one standard deviation of the F_{IS} of a closely related species with similar reproductive strategies and demonstrated acceptable viability.”
- “Delisting Criteria 3b: Maintain presence in 80 percent of subpopulations over 20-year monitoring period and outside of the core populations, with any subpopulation extirpations compensated by a newly identified or colonized subpopulation.”
- Delisting Criteria 4: Develop and implement a Habitat Management Plan (HMP) for Sneed and Lee pincushion cacti conservation.”
- **Recovery Actions (5-Year Review, 2023):**
 - “Resolve the taxonomic identity of Sneed’s-form plants range-wide and in the Sneed’s-form core population area.”
 - “Survey suitable habitats as predicted by probabilistic models for the presence/absence and extent of Lee’s occurrences, starting with the Sargent Canyon occurrence area. Consider evaluating the feasibility of using aerially assisted remote sensing and artificial intelligence assisted object detection techniques to identify potentially occupied areas for on-the-ground presence/absence survey efforts.”
 - “Map the bounds of Lee’s occurrences within occupied areas, using standardized and repeatable methods.”
 - “Install randomly or systematically located demographic and density monitoring plots throughout the species’ range. Determine the plot specifications and sample sizes needed to achieve the desired statistical power experimentally.”
 - “Assess the probability of wildfire exposure in occurrence areas.”
 - “Assess microclimate refugia in and adjacent to occurrence areas.”
 - “Assess Lee’s resiliency to, and capacity to adapt to, projected future climate changes. If resiliency and adaptive capacity are low, identify future suitable habitat areas using probabilistic models that incorporate the range of available future climate scenarios and time periods.”
 - “Collect seeds along >50 maternal lines per occurrence area for ex-situ, long-term conservation storage. Consider what germplasm may be needed for successful reintroductions when planning collections.”
 - “Finalize protections for Lee’s occupied and adjacent and interviewing habitats, including future habitats, via special designations and associated mineral withdrawals and management prescriptions for the purpose of conserving Lee’s.”

3. Description of Species Range

- “We assign Sneed’s-form plants within the geographic range of plants exhibiting classic Lee’s morphology (appressed spines) to one core population and representation area (consisting of the Serpentine Bends/Dark Canyon/Crooked Creek, Walnut Canyon, Rattlesnake Canyon, North Slaughter Canyon/Middle Slaughter Canyon, Bear Canyon, Midnight Canyon, Putnam Canyon, West Slaughter Canyon, and Yucca Canyon occurrences) and Sneed’s-form plants beyond the geographic range of plants exhibiting classic Lee’s morphology to another (consisting of the Lefthook Canyon, Double Canyon, Cottonwood Canyon, Gunsight Canyon, and Big Canyon occurrences; 5-Year Review, 2023).”

4. Critical Habitat

- FWS has not designated a critical habitat for this species (<https://ecos.fws.gov/ecp/species/2504>)

5. Known Locations

- **Known Locations Described in FWS 5-Year Review (2023)**

- Lee’s currently occupies 2-3 geographically isolated and genetically areas, depending on phylogenetic analysis results: one core Lee’s population (consisting of the Serpentine Bends/Dark Canyon/Crooked Creek, Walnut Canyon, Rattlesnake Canyon, North Slaughter Canyon/Middle Slaughter Canyon, Bear Canyon, Midnight Canyon, Putnam Canyon, West Slaughter Canyon, and Yucca Canyon occurrences) and one core Sneed’s-form population (consisting of the Lefthook Canyon, Double Canyon, Cottonwood Canyon, Gunsight Canyon, and Big Canyon occurrences), as well as a third, isolated, Lee’s individual (Sargent Canyon). Locations are listed in **Table 1**.
- “In 2020, 122 plants were documented during hasty presence/absence surveys. Therefore, there’s potential that a significant, undiscovered, Lee’s population exists in the Sargent Canyon area. Further, vast areas of potential habitat between Sargent Canyon and Serpentine Bends remain unsurveyed, so there’s potential for future discovery of additional, intervening Lee’s populations as well.”

Table 2. Occurrences of the Lee pincushion cactus from the 2023 FWS 5-year review.

Occurrence Area	Putative Taxon	Lee’s Documented	Sneed’s-form Documented	Guadalupensis Documented
Big Canyon	Guadalupensis	N	Y	Y
Gunsight Canyon	Undetermined	N	Y	N
Cottonwood Canyon	Guadalupensis	N	Y	Y
Double Canyon	Undetermined	N	Y	N
Lefthook Canyon	Undetermined	N	Y	N
West Slaughter Canyon	Lee’s	Y	Y	N
Yucca Canyon	Lee’s	Y	Y	N
Putnam Canyon	Lee’s	Y	Y	N
Midnight Canyon	Lee’s	Y	Y	N
Middle Slaughter Canyon and North Slaughter Canyon	Lee’s	Y	N	N
Bear Canyon*	Undetermined	N	Y	N

Occurrence Area	Putative Taxon	Lee's Documented	Sneed's-form Documented	Guadalupeensis Documented
Rattlesnake Canyon	Lee's	Y	Y	N
Walnut Canyon	Lee's	Y	N	N
Serpentine Bends, Dark Canyon, and Crooked Creek	Lee's	Y	Y	N
Sargent Canyon	Lee's	Y	N	N

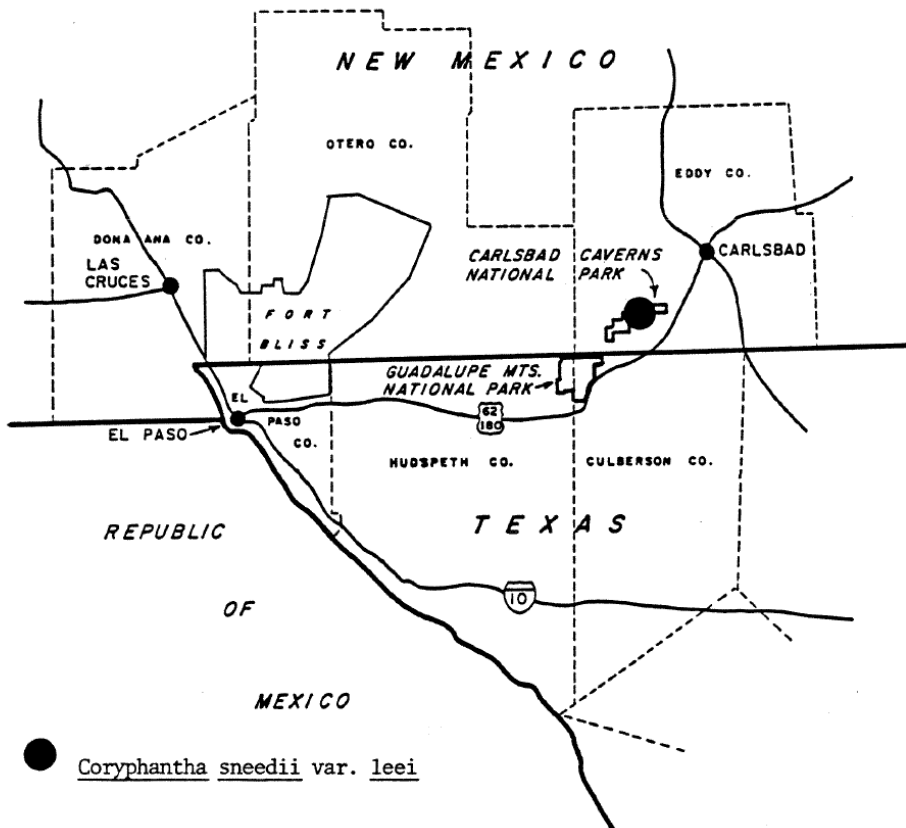


Figure 1. General location of *Coryphantha sneedii* var. *leei* from FWS Recovery Plan, 1986.

- **Occurrences Included in Public Databases**
 - EPA queried iNaturalist, GBIF, and NatureServe. Collectively, the occurrence data are consistent with the population locations identified in the FWS 2018 Recovery Plan, with majority of the occurrences falling within those identified locations.

- iNaturalist (available [here](#)) had 38 research grade observations for this species. 35 observations are within the range identified by FWS.
- GBIF (available [here](#)) included 17 occurrences and human observations (from 1977-2025). 13 of these observations are included in iNaturalist and the other 4 are from Nature Serve. GBIF points are within the range identified by FWS.
- Occurrences in NatureServe were consistent with other occurrence data (linked [here](#)) for 8 documented distributions.

Appendix 2. GIS Data Review and Method to Develop Core Map

This core map was created based on the range with habitat refinements, including occupied location and species habitat. EPA used the FWS range file from 2025 as the starting point for developing this core map. The core map was further refined by limestone geology and the removal of forested areas.

1. Dataset References and Software

- National Land Cover Database (NLCD)^{Error! Bookmark not defined.}
- The State Geologic Map Compilation (SGMC) Geodatabase of the Conterminous United States²
- Software used: ArcGIS Pro 3.2
- FWS Species Range – last updated on 6/24/2025

2. Datasets Used in Core Map Development

All datasets used in core map development are described in EPA's process document.

3. Core Map Development

- EPA started with the species range documented in FWS documents.
- This species is only documented occurring on limestone geology, so EPA used the SGMC data set to only include limestone geology. Additionally, to make sure all known locations are encompassed for the species Lincoln National Forest, Carlsbad National Park, and Guadalupe Mountain National Park lands were included.
- All layers were meagered together, NLCD land cover data was clipped to the area.
- Raster to polygon
- Pairwise dissolve was used to condense land cover data of the same class name.
- NLCD land cover data was used to remove forested areas since this species does not occur in forested habitat.

This area is also representative of other occurrence data sources including iNaturalist, GBIF and NatureServe.