



Conservation Gap Analysis of Native U.S. Oaks

Species profile: *Quercus carmenensis*

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SPECIES OF CONSERVATION CONCERN

CALIFORNIA

Channel Island endemics:
Quercus pacifica, *Quercus tomentella*

Southern region:
Quercus cedrosensis, *Quercus dumosa*,
Quercus engelmannii

Northern region and /
or broad distribution:
Quercus lobata, *Quercus parvula*,
Quercus sadleriana

SOUTHWESTERN U.S.

Texas limited-range endemics
Quercus carmenensis,
Quercus graciliformis, *Quercus hinckleyi*,
Quercus robusta, *Quercus tardifolia*

Concentrated in Arizona:
Quercus ajoensis, *Quercus palmeri*,
Quercus toumeyi

Broad distribution:
Quercus havardii, *Quercus laceyi*

SOUTHEASTERN U.S.

State endemics:
Quercus acerifolia, *Quercus boyntonii*

Concentrated in Florida:
Quercus chapmanii, *Quercus inopina*,
Quercus pumila

Broad distribution:
Quercus arkansana, *Quercus austrina*,
Quercus georgiana,
Quercus oglethorpensis, *Quercus similis*



Quercus carmenensis C.H.Müll.

Synonyms: N/A Common Names: Del Carmen oak, Mexican oak, Sierra del Carmen oak

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Suggested citation: Beckman, E., Still, S. M., Meyer, A., & Westwood, M. (2019). *Quercus carmenensis* C.H.Müll. In Beckman, E., Meyer, A., Man, G., Pivorunas, D., Denvir, A., Gill, D., Shaw, K., & Westwood, M. *Conservation Gap Analysis of Native U.S. Oaks* (pp. 80-85). Lisle, IL: The Morton Arboretum. Retrieved from <https://www.mortonarb.org/files/species-profile-quercus-carmenensis.pdf>



DISTRIBUTION AND ECOLOGY

Quercus carmenensis, also known as Del Carmen oak, is only recorded in the U.S. within Brewster County in southwestern Texas, and is originally known from the Sierra del Carmen region in Coahuila, Mexico. Michael Powell made the first U.S. collections of *Q. carmenensis* in 1982, on the slopes of Casa Grande Peak within the Chisos Mountains of Big Bend National Park. In 1991, Powell documented the species at a second location in the park, Laguna Meadows, and specimens were also verified by Billy Turner. However, since their discovery, attempts to find the species at either site have been inconclusive (S. Still pers. comm., 2018).¹ Although, on a recent collecting trip seeking *Q. carmenensis* in its documented Texas location, experts could not confidently identify the species; this calls into question the species' occurrence in the U.S. If Del Carmen oak is not present in the U.S., original documentation could have misidentified the species, or hybridization with *Q. intricata* and/or *Q. grisea* have diluted *Q. carmenensis* individuals past clear identification. Oak hybridization is rampant in the region and correctly identifying species is quite difficult (A. Black pers. comm., 2018). Photos of what could be *Q. carmenensis* have been provided. Ideal environmental factors for *Q. carmenensis* include shallow soils and shrublands or woodlands of high intermountain valleys, 2,000 to 2,500 meters above sea level, especially slopes with north or northwest facing exposures. The species is typically a shrub, one-half to two meters tall, but on better sites can grow to be a small tree, reaching 12 meters high, with a maximum height of about 15 meters, and trunk diameter of 0.75 meters wide (S. Still pers. comm., 2018).

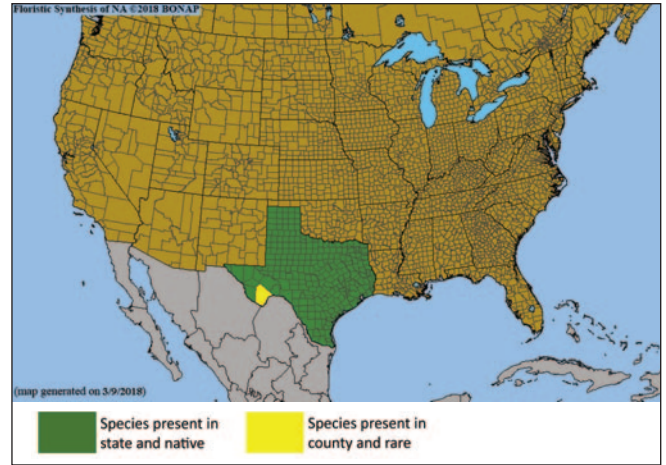


Figure 1. County-level distribution map for the U.S. distribution of *Quercus carmenensis*. Source: Biota of North America Program (BONAP).²

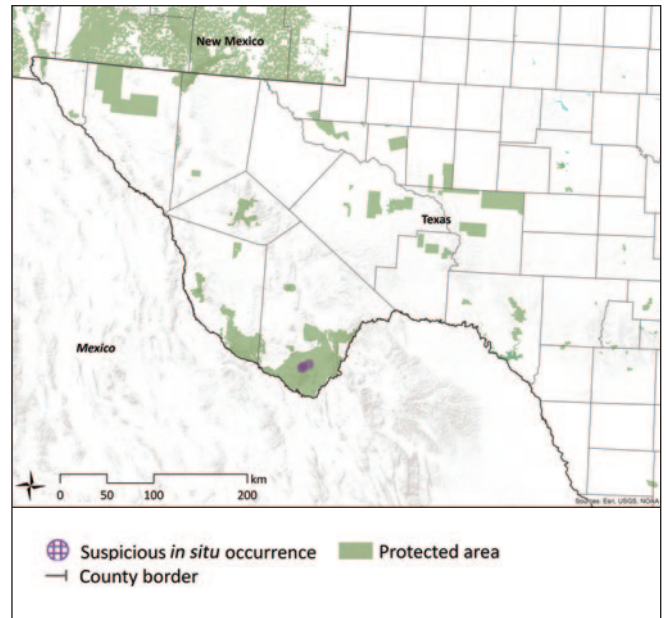


Figure 2. Documented *in situ* occurrence points for the U.S. distribution of *Quercus carmenensis*. Protected areas layer from U.S. Geological Survey Gap Analysis Program (GAP) 2016 Protected Areas Database of the U.S. (PAD-US).³

VULNERABILITY OF WILD POPULATIONS

Table 1. Scoring matrix identifying the most severe demographic issues affecting *Quercus carmenensis*. Cells are highlighted when the species meets the respective vulnerability threshold for each demographic indicator. Average vulnerability score is calculated using only those demographic indicators with sufficient data (i.e., excluding unknown indicators).

Demographic indicators	Level of vulnerability						Score
	Emergency Score = 40	High Score = 20	Moderate Score = 10	Low Score = 5	None Score = 0	Unknown No score	
Population size	< 50	< 250	< 2,500	< 10,000	> 10,000	Unknown	5
Range/endemism	Extremely small range or 1 location	E00 < 100 km ² or A00 < 10 km ² or 2-4 locations	E00 < 5,000 km ² or A00 < 500 km ² or 5-9 locations	E00 < 20,000 km ² or A00 < 2,000 km ² or 10+ locations	E00 > 20,000 km ² or A00 > 2,000 km ²	Unknown	10
Population decline	Extreme	>= 80% decline	>= 50% decline	>= 30% decline	None	Unknown	5
Fragmentation	Severe fragmentation	Isolated populations	Somewhat isolated populations	Relatively connected populations	Connected populations	Unknown	20
Regeneration/recruitment	No regeneration or recruitment	Decline of >50% predicted in next generation	Insufficient to maintain current population size	Sufficient to maintain current population size	Sufficient to increase population size	Unknown	-
Genetic variation/integrity	Extremely low	Low	Medium	High	Very high	Unknown	20
Average vulnerability score							12.0
Rank relative to all U.S. oak species of concern (out of 19)							6

THREATS TO WILD POPULATIONS

High Impact Threats

Genetic material loss — inbreeding and/or introgression: If the species is present in the U.S., regular hybridization with *Q. intricata* and/or *Q. grisea* is highly likely, threatening the genetic integrity of *Q. carmenensis* (A. Black pers. comm., 2018).

Extremely small and/or restricted population: If present in the U.S., Del Carmen oak has a very restricted range and only a few individuals have been documented over the past 30 years during multiple surveys.¹ Recent visits to the putative sites in the Chisos Mountains have been inconclusive (S. Still pers. comm., 2018).

Moderate Impact Threats

Human use of landscape — agriculture, silviculture, ranching, and/or grazing: *Quercus carmenensis* does occur in the Maderas Del Carmen Flora and Fauna Protection Area in Mexico, however a combination of communal land use for agriculture and grazing, as well as private land holdings, still exist in much of the Sierra del Carmen region. These land uses may pose future threats to the species.¹ Extensive grazing activity has also altered the hydrology of streams and groundwater in the region, which could impact the vitality of *Q. carmenensis*.⁴

Low Impact Threats

Human modification of natural systems — invasive species competition: Invasive plant species pose a significant threat to the unique and rare species within Big Bend National Park, but this threat has not yet been recorded for *Q. carmenensis*.⁵

Climate change — habitat shifting, drought, temperature extremes, and/or flooding: Drought, flood, and fire all pose threats, especially since the potential population within Big Bend National Park could be wiped out by one extreme event (A. McNeil-Marshall pers. comm., 2016).

CONSERVATION ACTIVITIES

In 2017 *Quercus* accessions data were requested from *ex situ* collections. A total of 162 institutions from 26 countries submitted data for native U.S. oaks (Figure 3). Past, present, and planned conservation activities for U.S. oak species of concern were also examined through literature review, expert consultation, and conduction of a questionnaire. Questionnaire respondents totaled 328 individuals from 252 organizations, including 78 institutions reporting on species of concern (Figure 5).

Results of 2017 *ex situ* survey

Number of <i>ex situ</i> collections reporting this species:	1
Number of plants in <i>ex situ</i> collections:	2
Average number of plants per institution:	2
Percent of <i>ex situ</i> plants of wild origin:	100%
Percent of wild origin plants with known locality:	100%

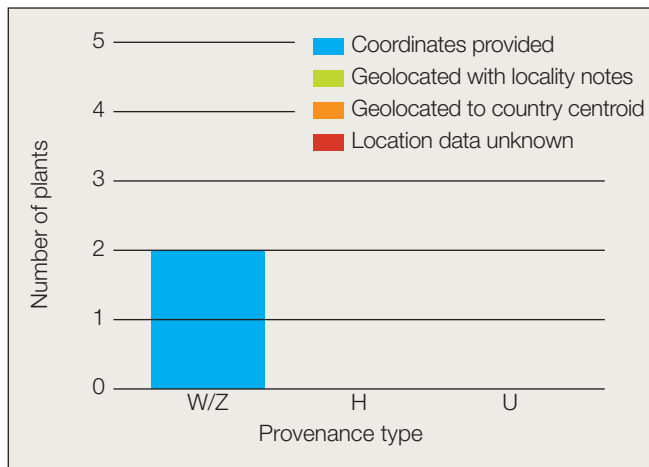


Figure 3. Number and origin of *Quercus carmenensis* plants in *ex situ* collections. Provenance types: W = wild; Z = indirect wild; H = horticultural; U = unknown.



A spatial analysis was conducted to estimate the geographic and ecological coverage of *ex situ* collections (Figure 4). Only the native U.S. distribution of the species was considered in this analysis, due to availability of ecoregion maps. Fifty-kilometer buffers were placed around each *in situ* occurrence point and the source locality of each plant living in *ex situ* collections. Collectively, the *in situ* buffer area serves as the inferred native range of the species, or “combined area *in situ*” (CAI50). The *ex situ* buffer area represents the native range “captured” in *ex situ* collections, or “combined area *ex situ*” (CAE50). Geographic coverage of *ex situ* collections was estimated by dividing CAI50 by CAE50. Ecological coverage was estimated by dividing the number of EPA Level IV Ecoregions present in CAE50 by the number of ecoregions in CAI50.

Estimated *ex situ* representation

Geographic coverage:	0%
Ecological coverage:	0%

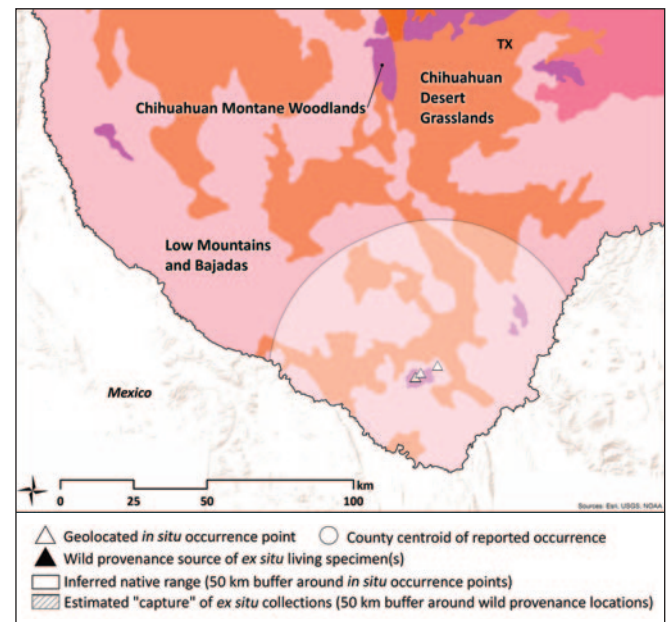


Figure 4. *Quercus carmenensis* *in situ* occurrence points and *ex situ* collection source localities within the United States. U.S. EPA Level IV Ecoregions are colored and labelled.⁶ County centroid is shown if no precise locality data exist for that county of occurrence. Email treeconservation@mortonarb.org for more information regarding specific coordinates.

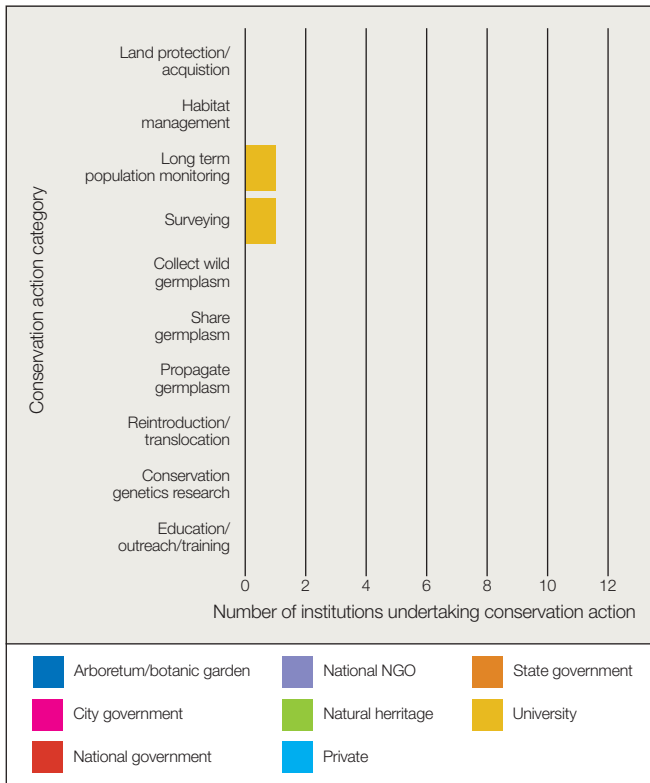


Figure 5. Number of institutions reporting conservation activities for *Quercus carmenensis* grouped by organization type. One of 252 institutions reported activities focused on *Q. carmenensis* (see Appendix D for a list of all responding institutions).

Land protection: Within the inferred native range of *Q. carmenensis* in the U.S., 62% of the land is covered by protected areas (Figure 6). However, because this species' distribution is small and well-documented, we know that 100% of the species' potential occurrences within the U.S. are within protected areas.

If present in the U.S., populations of *Q. carmenensis* are completely within Big Bend National Park, and well protected from human impact. The Critical Ecosystem Partnership Fund also defines Madrean Pine-Oak Woodlands of Mexico as a biodiversity hotspot, which could incentivise further protection.⁷

Sustainable management of land: The Ecoregional Conservation Assessment of the Chihuahuan Desert ranks Big Bend Triangle with the highest Irreplaceability Index and 9th highest overall conservation priority out of 39 areas of conservation concern in Texas.⁴ Big Bend Triangle is currently the only potential location of Del Carmen oak in the U.S. The 2012 Texas Conservation Action Plan: Chihuahuan Desert and Arizona-New Mexico Mountains Ecoregions Handbook outlines general trends and needs in the region as a whole, including Big Bend National Park; there is no specific mention of *Q. carmenensis* outside the "Species of Greatest Conservation Need" list.⁸

Population monitoring and/or occurrence surveys: A vegetation survey was conducted in the Sierra del Carmen in 1997 and within Big Bend National Park in 1998. *Quercus carmenensis* was on the plant checklist used for the surveys.⁹ There have been three visits to the Chisos Mountains since 2016 to find and collect *Q. carmenensis* germplasm. Two teams were able to find some plants that could be *Q. carmenensis*, but identification of the individuals is uncertain and there is question as to the validity of the species' presence in the Chisos Mountains at locations visited (S. Still pers. comm., 2018).¹⁰

Wild collecting and/or ex situ curation: Members of the International Oak Society completed a fruitful *Q. carmenensis* collecting trip in 2010 within the Sierra del Carmen of Coahuila, Mexico.¹¹ In 2017, an expedition worked to collect the species in southwestern Texas, to no avail. The next year, with support from the APGA-USFS Tree Gene Conservation Program, a second collecting trip was executed, and still no individuals were confidently identified. No acorns were present on individuals that bared the most similarity to *Q. carmenensis*, but germplasm was collected for ex situ growth and study (S. Still pers. comm., 2018).¹⁰

Propagation and/or breeding programs: No known initiatives at the time of publication.

Reintroduction, reinforcement, and/or translocation: No known initiatives at the time of publication.

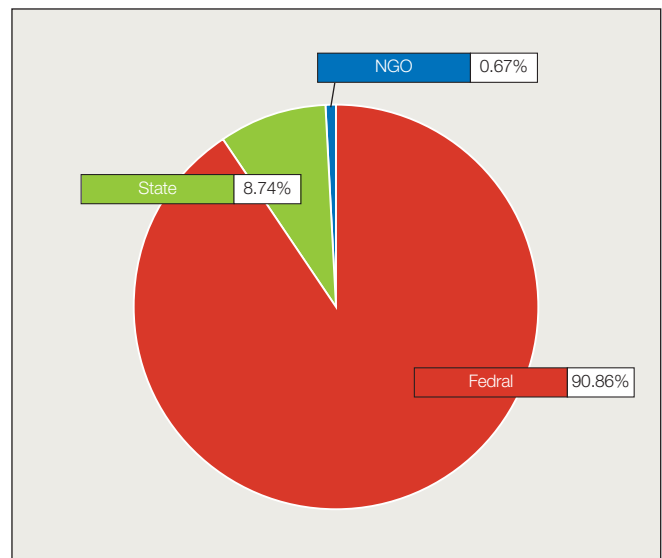


Figure 6. Management type of protected areas within the inferred native range of *Quercus carmenensis*. Protected areas data from the U.S. Geological Survey Gap Analysis Program (GAP) 2016 Protected Areas Database of the U.S. (PAD-US).³

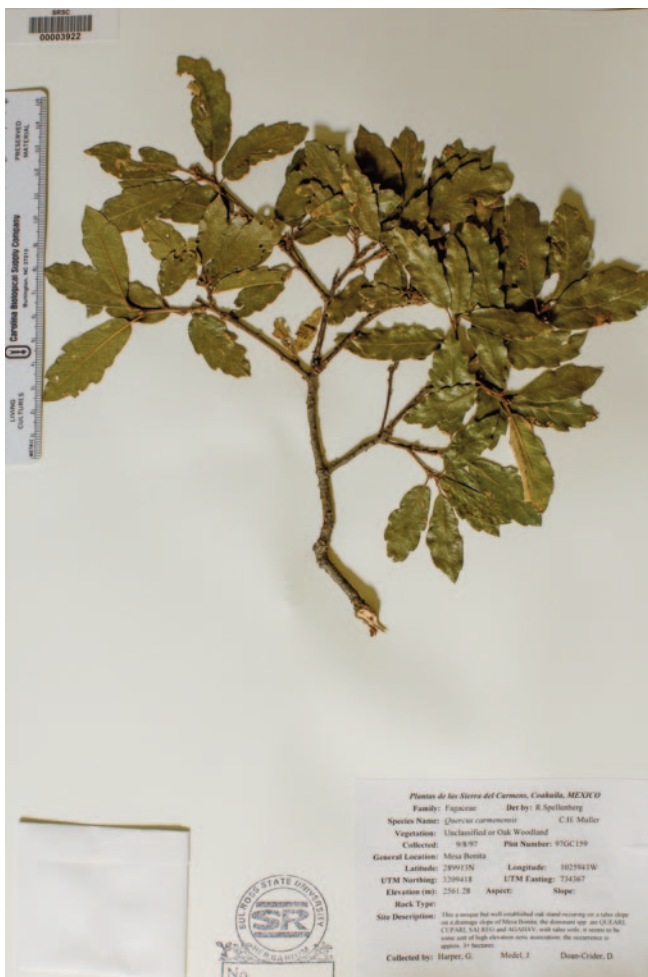
Research: The Ecoregional Conservation Assessment of the Chihuahuan Desert also outlines areas needing conservation research within *Q. carmenensis*' range. They emphasize the role of site-specific conservation planning and "implementation of creative strategies to abate such threats as altered hydrology of streams and groundwater, poor grazing practices, and invasive animals and plants," which require working at multiple scales and sustaining partnerships with stakeholders such as multi-generation ranching landowners.⁴

Education, outreach, and/or training: No known initiatives at the time of publication.

Species protection policies: In addition to listing species as endangered or threatened, Texas maintains a list of more than 1,300 Species of Greatest Conservation Need (SGCN). These species are "declining or rare and in need of attention to recover or to prevent the need to list under state or federal regulation...[and are] the focus of Texas Parks and Wildlife Department's Texas Conservation Action Plan," but are not provided the same protections as endangered or threatened species. *Quercus carmenensis* is listed as a SGCN.¹²

PRIORITY CONSERVATION ACTIONS

Del Carmen oak appears to be in a good position for ample conservation due to its protection within Big Bend National Park. However, there are only two putative populations documented, and difficulties in identification of the Chisos Mountain populations create uncertainty as to whether the species is extant in the U.S. Despite a few trips to the region since 2016 to search for *Q. carmenensis*, the species has still not been verified in the Chisos Mountains. The species may still be present in the region, but it is possible there are fewer individuals or that they have hybridized with other taxa in the area, becoming more difficult to identify. Molecular research should be conducted to compare the samples taken in the U.S. in August 2018 with verified samples of *Q. carmenensis* from Mexico. It would be useful to revisit populations in the Sierra del Carmen mountains of Mexico to compare with live individuals found putatively in the U.S. Further wild collecting efforts in Mexico should also be carried out to secure more germplasm in *ex situ* collections. Propagation followed by reinforcement and/or translocation could be considered if populations are not currently sustainable.



Conservation recommendations for *Quercus carmenensis*

Highest Priority

- Population monitoring and/or occurrence surveys
- Research (taxonomy/phylogenetics)
- Wild collecting and/or *ex situ* curation

Recommended

- Propagation and/or breeding programs
- Reintroduction, reinforcement, and/or translocation



REFERENCES

1. **Kenny, L., Wenzell, K., & Beckman, E. (2016).** *Quercus carmenensis*. The IUCN Red List of Threatened Species 2016: e.T194072A2296216. Retrieved from <http://dx.doi.org/10.2305/IUCN.UK.2016-1.RLTS.T194072A2296216.en>
2. **Kartesz, J. T. (2018).** The Biota of North America Program (BONAP). Taxonomic Data Center, Floristic Synthesis of North America, Version 1.0. Chapel Hill, NC. Retrieved from <http://www.bonap.net/tdc>
3. **U.S. Geological Survey, Gap Analysis Program (GAP). (2016, May).** Protected Areas Database of the United States (PAD-US). Version 1.4 Combined Feature Class. Retrieved from <https://gapanalysis.usgs.gov/padus/data/download/>
4. **Pronatura Noreste, The Nature Conservancy, & World Wildlife Fund. (2004).** Ecoregional conservation assessment of the Chihuahuan Desert (Second edition). Retrieved from [https://www.conservationgateway.org/ConservationPlanning/SettingPriorities/EcoregionalReports/Documents/Chihuahuan Desert Report.pdf](https://www.conservationgateway.org/ConservationPlanning/SettingPriorities/EcoregionalReports/Documents/Chihuahuan%20Desert%20Report.pdf)
5. **National Park Service. (2016).** *Foundation document, Big Bend National Park*. TX: U.S. Department of the Interior. Retrieved from <http://www.nps.history.com/publications/foundation-documents/bibe-fd-2016.pdf>
6. **U.S. EPA Office of Research & Development. (2013, April).** Ecoregions of the Conterminous United States. National Health and Environmental Effects Research Laboratory (NHEERL). Retrieved from ftp://ftp.epa.gov/wed/ecoregions/us/us_eco_14.zip
7. **Critical Ecosystem Partnership Fund. (n.d.).** Madrean Pine-Oak Woodlands. Retrieved from <https://www.cepf.net/our-work/biodiversity-hotspots/madrean-pine-oak-woodlands>
8. **Texas Parks and Wildlife Department. (2012).** *Texas conservation action plan: Chihuahuan Desert and Arizona-New Mexico mountains ecoregions handbook*. Connally, W. (Ed.). Austin, TX. Retrieved from https://tpwd.texas.gov/landwater/land/tcap/documents/chih_tcap_2012.pdf
9. **Muldavin, E. H., Harper, G., Neville, P., & Wood, S. (2014).** A vegetation classification of the Sierra del Carmen, U.S.A. and Mexico. In Hoyt, C. A., & Karges, J. (Eds.), *Proceedings of the sixth symposium on the natural resources of the Chihuahuan Desert region, October 14–17*. Fort Davis, TX: Chihuahuan Desert Research Institute. Retrieved from <http://www.cdri.org/symposium-proceedings.html>
10. **Still, S., Griswold, E., & McNeil-Marshall, A. (2016).** *Scouting and collection trips for Trans-Pecos Quercus germplasm: APGA-USFS Tree Gene Conservation Partnerships*. Retrieved from <https://www.publicgardens.org/file/2016-trans-pecosoaksreportpdf>
11. **Chassé, B. (2011, January 5).** 9490 kilometres across Mexico, Sep.-Oct. 2010. International Oak Society. Retrieved from <http://www.internationaloaksociety.org/content/9490-kilometres-across-Mexico-sep-oct-2010>
12. **Texas Parks and Wildlife Department. (2013).** Species of greatest conservation need. Retrieved from https://tpwd.texas.gov/huntwild/wild/wildlife_diversity/nongame/tcap/sgcn.phtml