



Conservation Gap Analysis of Native U.S. Oaks

Species profile: *Quercus toumeyi*

Emily Beckman, Tim Thibault, Abby Meyer, Murphy Westwood

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 toumeyi Sarg.

Synonyms: *Quercus chuhuichupensis* C.H.Müll., *Q. hartmanii* Trel. **Common Names:** Toumey oak

Species profile co-author: Tim Thibault, The Huntington

Contributors: John Wiens, Department of Ecology and Evolutionary Biology, The University of Arizona

Suggested citation: Beckman, E., Thibault, T., Meyer, A., & Westwood, M. (2019). *Quercus toumeyi* Sarg. 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. 216-221). Lisle, IL: The Morton Arboretum. Retrieved from <https://www.mortonarb.org/files/species-profile-quercus-toumeyi.pdf>



DISTRIBUTION AND ECOLOGY

Since the discovery of *Quercus barrancana*, and its taxonomic acceptance in 2014, the range of *Quercus toumeyi*, or Toumey oak, has somewhat greater uncertainty. In his definition of *Q. barrancana*, Spellenberg asserts that what was originally called the southern variety of *Q. toumeyi*, located in north-central Mexico, should now accurately be labeled *Q. barrancana*. He also states that subpopulations of Toumey oak recorded in western Texas may really represent forms of *Q. turbinella*; he was only able to find introgressed *Q. toumeyi* in that region.¹ Therefore the species presence is unconfirmed in Texas. The range of *Quercus toumeyi* is now thought to stretch from southeastern Arizona (Pima, Santa Cruz, and Cochise Counties) and the southwestern corner New Mexico (Hidalgo County) in the U.S., and south to Yécora and Madera in the Mexican states of Sonora and Chihuahua, respectively. Toumey oak exists as a shrub or small tree within oak woodlands, pine-oak forests, and chaparral. It is a dominant species within evergreen broad-leaved shrublands, especially on rocky, dry slopes, and is a characteristic species of Madrean Encinal shrubland of the Sierra Madre as well as Mongollon and Coahuilan Chaparral. The species occurs from 1,200 to 2,400 meters above sea level.⁶

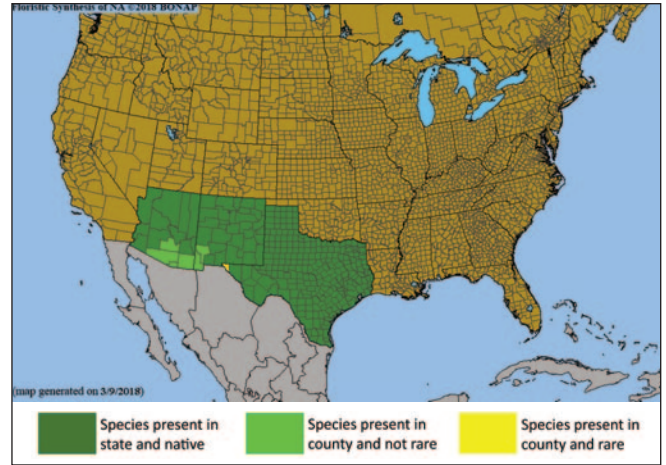


Figure 1. County-level distribution map for the U.S. distribution of *Quercus toumeyi*. Source: Biota of North America Program (BONAP).³

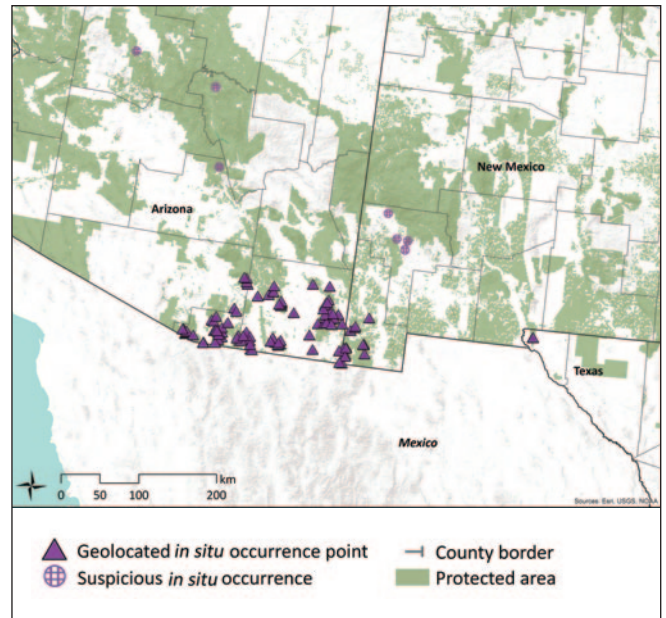


Figure 2. Documented *in situ* occurrence points for the U.S. distribution of *Quercus toumeyi*. Protected areas layer from U.S. Geological Survey Gap Analysis Program (GAP) 2016 Protected Areas Database of the U.S. (PAD-US).⁴

VULNERABILITY OF WILD POPULATIONS

Table 1. Scoring matrix identifying the most severe demographic issues affecting *Quercus toumeyi*. 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	0
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	0
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	5
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	5
Genetic variation/integrity	Extremely low	Low	Medium	High	Very high	Unknown	10
Average vulnerability score							4.2
Rank relative to all U.S. oak species of concern (out of 19)							16

THREATS TO WILD POPULATIONS

High Impact Threats

Genetic material loss — inbreeding and/or introgression: Introgression has likely eliminated the subpopulation that may have once occupied western Texas.⁵ Hybridization or introgression with *Q. arizonica* and *Q. oblongifolia* has also been noted within the species' main U.S. distribution (T. Thibault pers. comm., 2018).

Moderate Impact Threats

Human use of landscape — agriculture, silviculture, ranching, and/or grazing: NatureServe lists *Q. toumeyi* as a major component of three plant associations: *Quercus toumeyi* / *Bouteloua curtipendula* Scrub, *Quercus toumeyi* / *Muhlenbergia emersleyi* Scrub, and *Pinus discolor* / *Quercus toumeyi* Woodland; all three are all ranked as G1 or G2 (Critically Imperiled or Imperiled) and reported to have continued impact from grazing.²

Human modification of natural systems — disturbance regime modification, pollution, and/or eradication: Altered fire regime has created a downward spiral in ecosystem health, especially regarding the buildup of exotic grasses at lower elevations.⁶ Severe fires could spread upward to higher elevations and threaten populations of *Q. toumeyi* (T. Thibault pers. comm., 2018).

Climate change — habitat shifting, drought, temperature extremes, and/or flooding: Extended drought is one of the region's most urgent environmental issues, which is believed to be an effect of the changing climate.⁶

Low Impact Threats

Human use of species — wild harvesting: The *Quercus toumeyi* / *Bouteloua curtipendula* Scrub Association is reported to face some impact from firewood harvest.²

Human modification of natural systems — invasive species competition: Rapid spread of the invasive plant buffelgrass (*Pennisetum ciliare*) threatens the vitality of native plants in low elevations of the Sonoran Desert; its spread is facilitated by an increasing prevalence of severe fires that kill native plants and create room for exotic grasses.⁶ *Quercus toumeyi* is mostly associated with higher elevations not impacted by buffelgrass, but the exotic could be evolving and may become a problem on the edge of oak habitat. Currently, exotic *Eragrostis* species are the main displacers of native grasses at oak elevations, but it is unclear whether these invasive grasses have a negative impact on oak species (J. Wiens pers. comm., 2018).

Pests and/or pathogens: One or two different species of galls have been observed on Toumey oak, parasitized by *Phoradendron*. Some Toumey oak seeds are the target of the parasitization, and because of the species' small acorn, these seeds are even less likely to germinate or survive embryo rescue (T. Thibault pers. comm., 2018).

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 (Figures 3 and 4). 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 6).

Results of 2017 *ex situ* survey

Number of <i>ex situ</i> collections reporting this species:	3
Number of plants in <i>ex situ</i> collections:	10
Average number of plants per institution:	3
Percent of <i>ex situ</i> plants of wild origin:	80%
Percent of wild origin plants with known locality:	100%

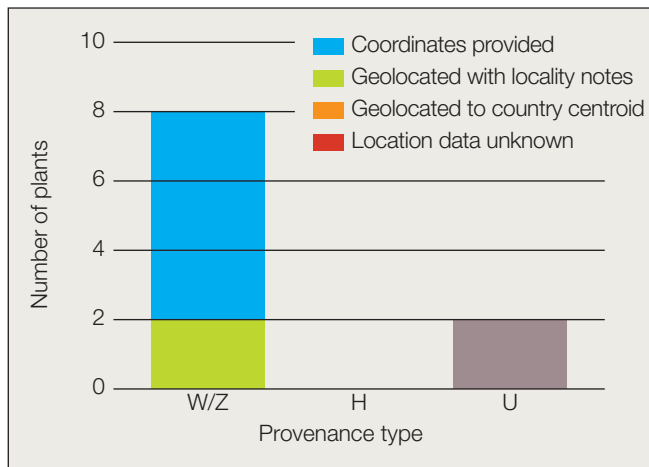


Figure 3. Number and origin of *Quercus toumeyi* plants in *ex situ* collections. Provenance types: W = wild; Z = indirect wild; H = horticultural; U = unknown.

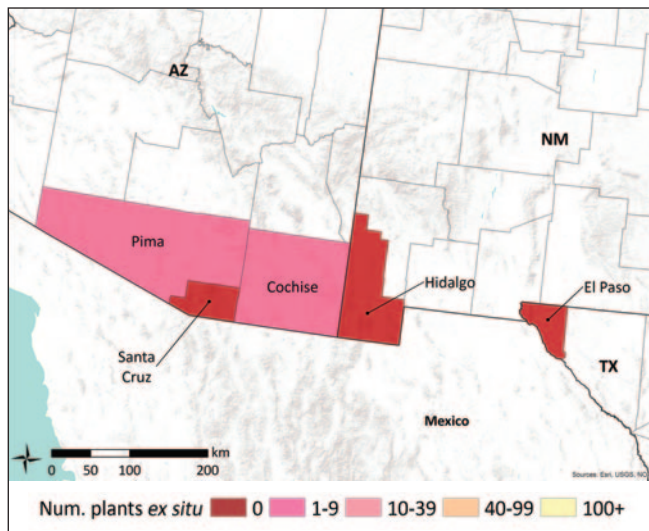


Figure 4. *Quercus toumeyi* counties of *in situ* occurrence, reflecting the number of plants from each county in *ex situ* collections.

A spatial analysis was conducted to estimate the geographic and ecological coverage of *ex situ* collections (Figure 5). 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:	36%
Ecological coverage:	69%

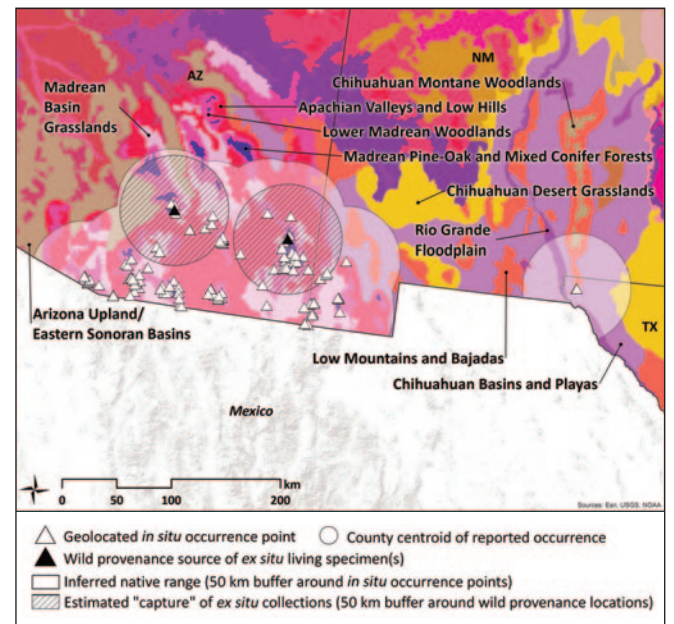


Figure 5. *Quercus toumeyi* *in situ* occurrence points and *ex situ* collection source localities within the United States. U.S. EPA Level IV Ecoregions are colored and labelled.⁷ County centroid is shown if no precise locality data exist for that county of occurrence. Email treeconservation@mortonarb.org for information regarding specific coordinates.



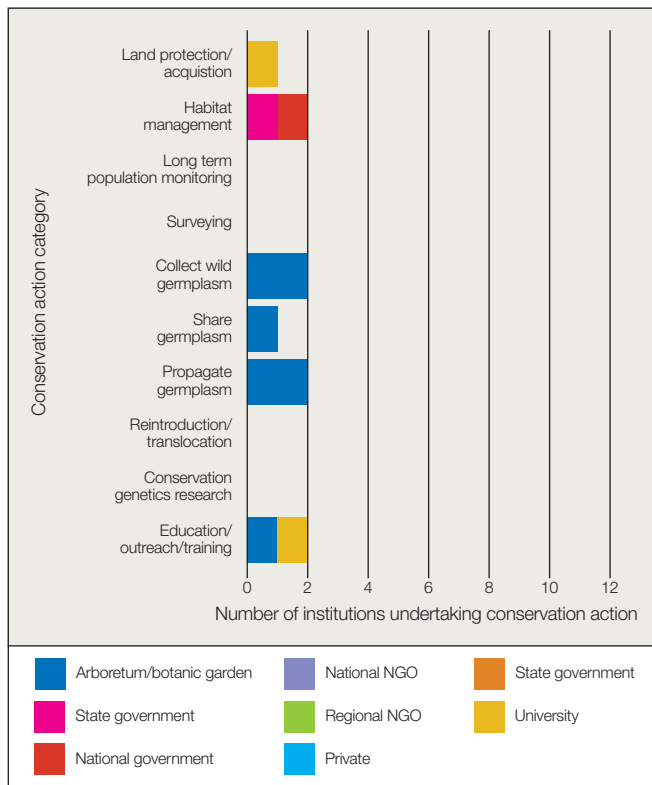


Figure 6. Number of institutions reporting conservation activities for *Quercus toumeyi* grouped by organization type. Five of 252 institutions reported activities focused on *Q. toumeyi* (see Appendix D for a list of all responding institutions).

Land protection: Within the inferred native range of *Q. toumeyi* in the U.S., 68% of the land is covered by protected areas (Figure 7). This is a very significant proportion. Energy should be focused on appropriate land management, to ensure a healthy native plant community.

Within the last ten years, The Nature Conservancy compiled an ecological and biological assessment of major landowners in Arizona and New Mexico. This publication provides a map of conservation areas, showing overlap with *Q. toumeyi*'s range. They estimate that almost 57 million acres (37.6%) of the land in Arizona and New Mexico is part of a network of priority conservation areas.⁸ *Toumey* oak is also observed within Las Cienegas National Conservation Area and Rancho El Aribabi.^{9,10}

Sustainable management of land: The R3 Species Database, which was developed by the USDA Forest Service in collaboration with The Nature Conservancy, has been used by The Nature Conservancy to identify priority species within National Forests; these findings could be used to update forest management plans.⁸ However, the priority species are all Endangered Species Act (ESA) listed plants, which does not include *Q. toumeyi*. By associating *Q. toumeyi* with ESA Threatened or Endangered species, some idea of land management status could be gained from The Nature Conservancy's review of Region 3.

Population monitoring and/or occurrence surveys: No known initiatives at the time of publication.

Wild collecting and/or ex situ curation: With funding from a 2018 APGA-USFS Tree Gene Conservation Program grant, The Huntington and Arizona-Sonora Desert Museum collected *Q. toumeyi* germplasm at 12 different mountain ranges in Arizona (Cochise, Pima, and Santa Cruz counties) and New Mexico (Hidalgo County). Germination to date ranges from 0-100% at The Huntington, averaging 55% (T. Thibault pers. comm., 2018).

Propagation and/or breeding programs: The APGA-USFS Tree Gene Conservation Program is also funding the propagation of germplasm from wild collections made in 2018. The Huntington, Arizona-Sonora Desert Museum, Boyce Thompson Arboretum, and Starhill Forest Arboretum are hosting the propagules, totaling about 60 seedlings. Most of the surviving plants were collected in Rucker Canyon (Cochise County, AZ) and along Geronimo Trail (Hidalgo County, NM; T. Thibault pers. comm., 2018).¹¹

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

Research: No known initiatives at the time of publication.

Education, outreach, and/or training: Two institutions reported this activity in the conservation action questionnaire, but no other details are currently known.

Species protection policies: No known initiatives at the time of publication.

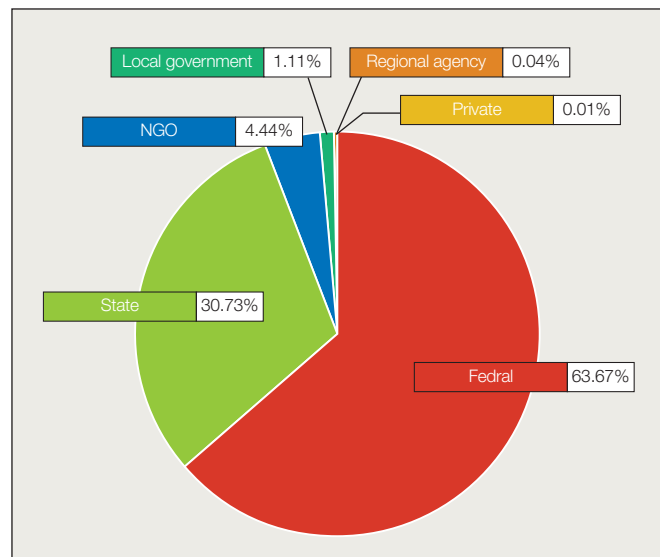
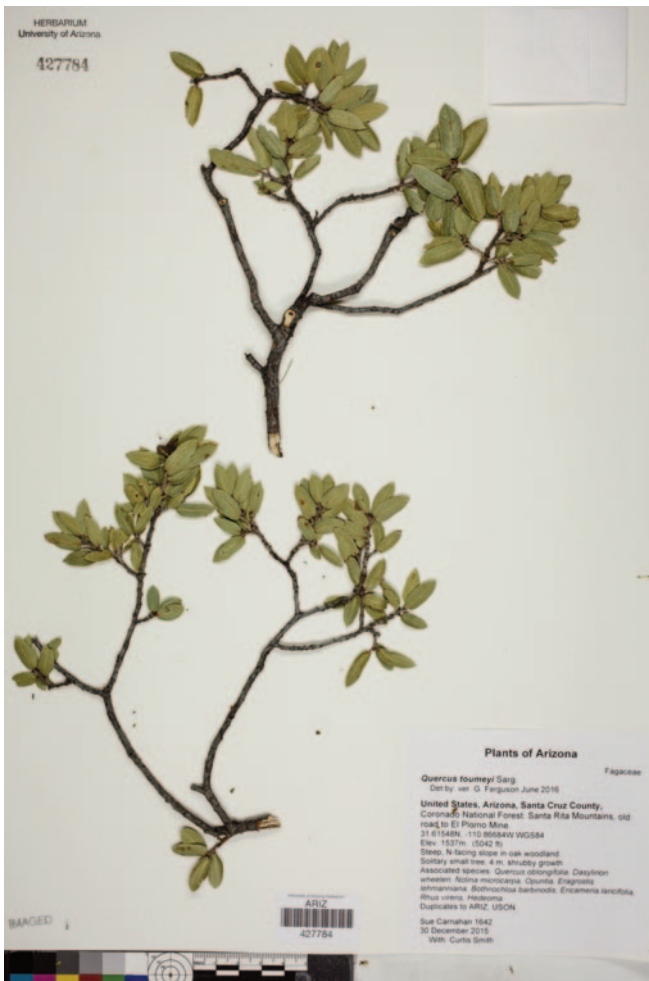


Figure 7. Management type of protected areas within the inferred native range of *Quercus toumeyi*. Protected areas data from the U.S. Geological Survey Gap Analysis Program (GAP) 2016 Protected Areas Database of the U.S. (PAD-US).⁴



Tim Thibault



PRIORITY CONSERVATION ACTIONS

The recent Red List of US Oaks listed Toumey oak as Data Deficient.¹² While the recognition of *Quercus barrancana* creates uncertainty about the southern extent of the range of *Q. toumeyi*, the species proper is known to occur in at least ten mountain ranges throughout Arizona and New Mexico. Nine of those ranges have populations on public or protected land (USFS, BLM, or The Nature Conservancy). When *Q. toumeyi* occurs, it is frequently locally common. The species crosses with *Q. arizonica* and *Q. oblongifolia* when co-occurring, opening the possibility of genetic loss through hybridization. Invasive grasses can increase fire danger, although a recent survey observed a population in the Chiricahua Mountains to have survived fire. However, sustainable management of land should remain a priority in the region. Climate change will likely change the spatial distribution of *Q. toumeyi*, potentially leading to greater fragmentation and separation of populations. While parasitic plants, gall-forming and seed parasitizing insects were observed on *Q. toumeyi*, none appears to be a threat to current populations. There is current need for monitoring to verify that populations are stable, and research to better understand the threat posed by hybridization. Additional field work is also required, primarily in Mexico, to define the southern geographic range. Adding additional populations to *ex situ* collections will help safeguard the species.

Conservation recommendations for *Quercus toumeyi*

Highest Priority

- Population monitoring and/or occurrence surveys

Recommended

- Research (climate change modeling; pests/pathogens; population genetics)
- Sustainable management of land
- Wild collecting and/or *ex situ* curation



REFERENCES

1. **Spellenberg, R. (2014).** *Quercus barrancana* (sect. *Quercus*, white oaks), a new species from northwestern Mexico. *Phytoneuron*, 105, 1-12. Retrieved from <http://phytoneuron.net/2014Phytoneuron/105PhytoN-Quercusbarrancana.pdf>
2. **NatureServe. (2017).** NatureServe Explorer: An online encyclopedia of life [online]. Version 7.1. Arlington, VA. Retrieved from <http://explorer.natureserve.org>
3. **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>
4. **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/>
5. **Romero Rangel, S., Rojas Zenteno, E. C., & Rubio Licona, L.E. (2015).** *Encinos de Mexico*. Universidad Nacional Autónoma de México.
6. **Arizona-Sonora Desert Museum. (n.d.).** Current projects - research and conservation. Retrieved from https://www.desertmuseum.org/center/current_projects.php
7. **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
8. **Lee, B. V., Smith, R., & Bate, J. (2008).** Ecological and biological assessments across major landowners in Arizona and New Mexico. In B. V. Lee & R. Smith, *Ecological and biological diversity of National Forests in Region 3*. Arlington, VA: Nature Conservancy. Retrieved from https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fsbdev3_021199.pdf
9. **Cooper, K. (2013).** Plants list: Observed at Rancho El Aribabi by Jesus Sanchez Escalante, Universidad de Sonora APNSAC. Retrieved from <http://elaribabi.com/plants-list/>
10. **Desert Research Learning Center. (n.d.).** Las Cienegas National Conservation Area. BLM-Safford. Retrieved from <http://swbiodiversity.org/seinet/checklists/checklist.php?cl=3121>
11. **American Public Gardens Association. (n.d.).** Tree Gene Conservation Partnership Showcase. R
12. **Jerome, D., Beckman, E., Kenny, L., Wenzell, K., Kua, C., & Westwood, M. (2017).** *Red List of US oaks*. Lisle, IL: The Morton Arboretum. Retrieved from https://www.mortonarb.org/files/Westwood_2017_Red%20List%20of%20Oaks.pdf