



Conservation Gap Analysis of Native U.S. Oaks

Species profile: *Quercus palmeri*

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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 palmeri Engelm.

Synonyms: *Quercus chrysolepis* var. *palmeri* (Engelm.) Engelm., **Common Names:** Palmer oak, Dunn oak

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DISTRIBUTION AND ECOLOGY

Quercus palmeri, or Palmer oak, is distributed across California, Arizona, and New Mexico, U.S., as well as stretching slightly into Baja California, Mexico. The Mojave Desert in southeastern California forms a barrier between the California and Arizona populations; morphology is clearly distinct between these disjunct populations, with the eastern group exhibiting classic *Q. palmeri* characteristics. The populations furthest east, though, in southeastern Arizona and New Mexico, are also morphologically unique and there is disagreement regarding the classification of these individuals as *Q. chrysolepis* affinity *Q. palmeri*. More research would be necessary to confirm introgression in the region (P. Manos pers. comm., 2018).¹ In California, the Southern Coast Range is relatively sparsely populated, with a higher concentration of individuals located further south within the coastal Transverse and Peninsular Ranges. On the east side of the desert, *Q. palmeri* populates the strip just south of the Colorado Plateau, and is most populous in central Arizona. Much of this species' distribution is composed of isolated subpopulations that are presumed to be relicts from a once-larger range that shrunk as aridity increased after the Pleistocene period.² Many of the isolated occurrences north of Riverside County, California, have been found to be single clones, and there is speculation that more localities will follow this pattern upon inspection.³ Palmer oak inhabits "canyons, mountain washes, dry thickets, and margins of chaparral communities."⁴ The species is usually associated with mesic, semi-desert landscapes, but also grows well near springs and in deeper valley soils of pinyon-juniper woodlands. Tolerance for a gradient of ecological conditions is evident. Compared to other oaks within the region (*Q. hypoleucoides*, *Q. arizonica*), *Q. palmeri* generally occupies lower elevations. It usually takes the form of a shrub or small tree, between one and three meters tall, but can reach up to six meters.⁵

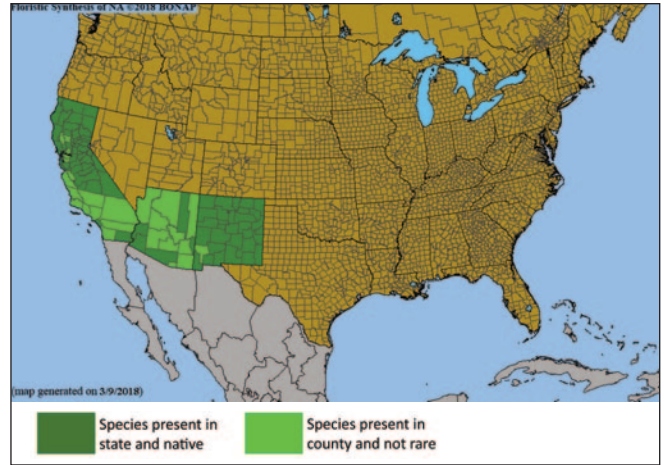


Figure 1. County-level distribution map for the U.S. distribution of *Quercus palmeri*. Source: Biota of North America Program (BONAP).⁶

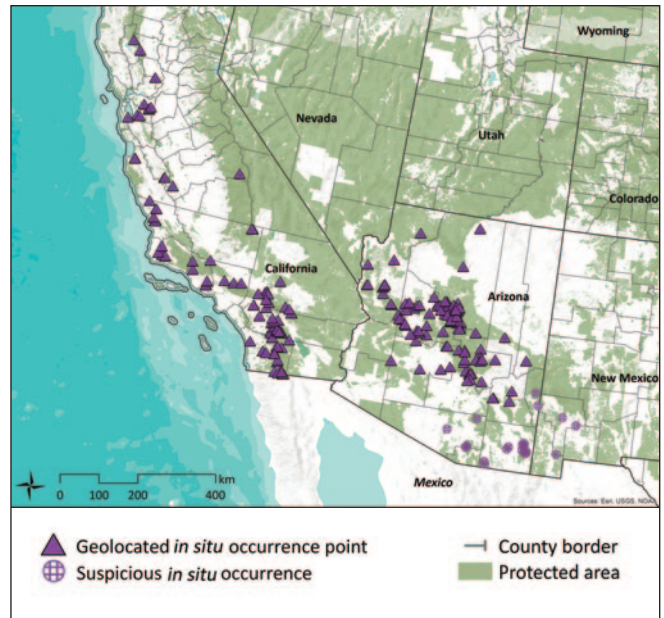


Figure 2. Documented *in situ* occurrence points for the U.S. distribution of *Quercus palmeri*. Protected areas layer from U.S. Geological Survey Gap Analysis Program (GAP) 2016 Protected Areas Database of the U.S. (PAD-US).⁷

VULNERABILITY OF WILD POPULATIONS

Table 1. Scoring matrix identifying the most severe demographic issues affecting *Quercus palmeri*. 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 | 0 |
| Fragmentation | Severe fragmentation | Isolated populations | Somewhat isolated populations | Relatively connected populations | Connected populations | Unknown | 10 |
| 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 | 10 |
| Genetic variation/integrity | Extremely low | Low | Medium | High | Very high | Unknown | 10 |
| Average vulnerability score | | | | | | | 5.0 |
| Rank relative to all U.S. oak species of concern (out of 19) | | | | | | | 15 |

THREATS TO WILD POPULATIONS

High Impact Threats

Human use of landscape — residential/commercial development, mining, and/or roads: Specific threats to *Q. palmeri* have not been directly studied, but many of the threats facing the less common but well-studied oaks of southern California apply to Palmer oak as well. Continued recreational, commercial, and residential development in the region leads to habitat conversion and degradation. Some of the densest subpopulations of *Q. palmeri* are in Riverside County, which is one of the fastest growing counties in California.⁸

Moderate Impact Threats

Human modification of natural systems — disturbance regime modification, pollution, and/or eradication: Altered fire regimes are thought to be affecting the regeneration success rate of Palmer oak.⁸

Genetic material loss — inbreeding and/or introgression: It has been proposed that morphologically aberrant populations identified as *Q. palmeri* in eastern Arizona and southwestern New Mexico are the result of hybridization with *Q. chrysolepis*. If true, this would significantly shrink *Q. palmeri*'s extent of occurrence.⁴

Low Impact Threats

Climate change — habitat shifting, drought, temperature extremes, and/or flooding: This oak may begin to experience the effects of severe fragmentation, including a depressed ability to adapt in response to climate change due to a smaller available gene pool.

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: | 18 |
| Number of plants in <i>ex situ</i> collections: | 41 |
| Average number of plants per institution: | 2 |
| Percent of <i>ex situ</i> plants of wild origin: | 66% |
| Percent of wild origin plants with known locality: | 96% |

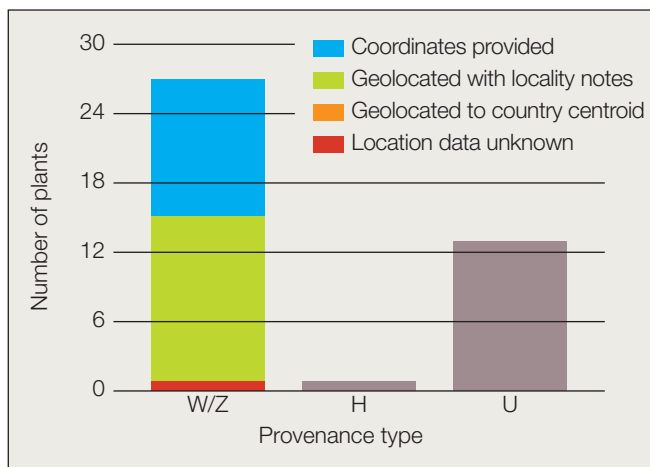


Figure 3. Number and origin of *Quercus palmeri* plants in *ex situ* collections. Provenance types: W = wild; Z = indirect wild; H = horticultural; U = unknown.

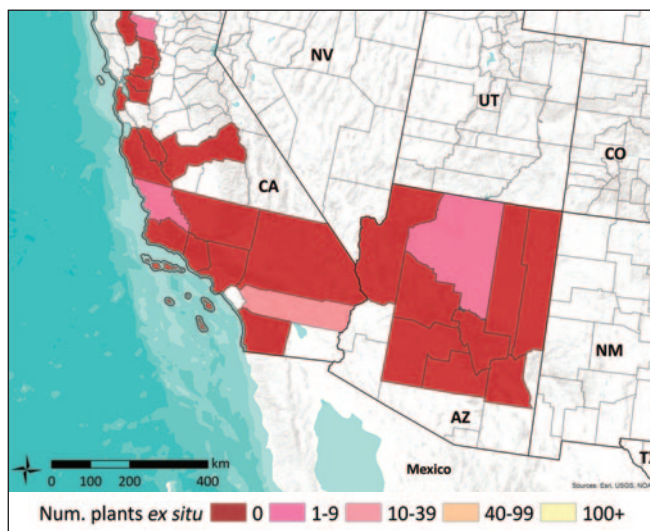


Figure 4. *Quercus palmeri* counties of *in situ* occurrence, reflecting the number of plants from each county in *ex situ* collections.

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: | 12% |
| Ecological coverage: | 30% |

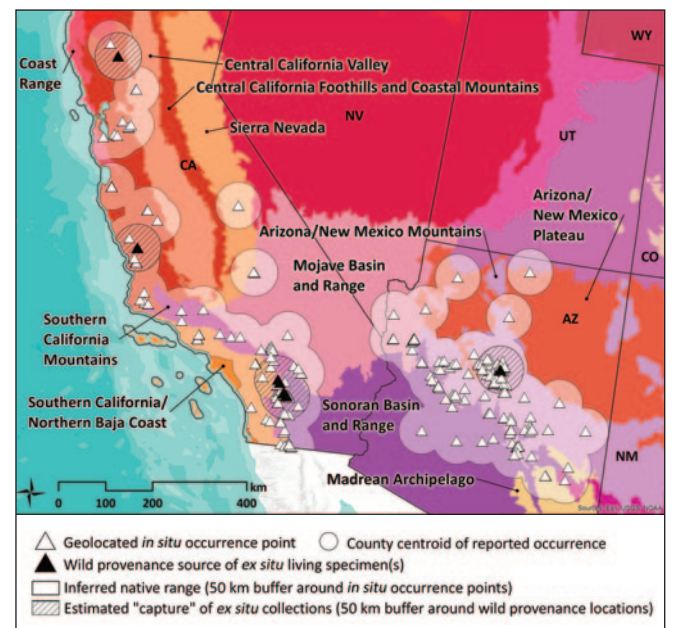


Figure 5. *Quercus palmeri* *in situ* occurrence points and *ex situ* collection source localities within the United States. U.S. EPA Level III Ecoregions are colored and labeled.⁹ County centroid is shown if no precise locality data exist for that county of occurrence. Email treeconservation@mortonarb.org for information regarding specific coordinates.



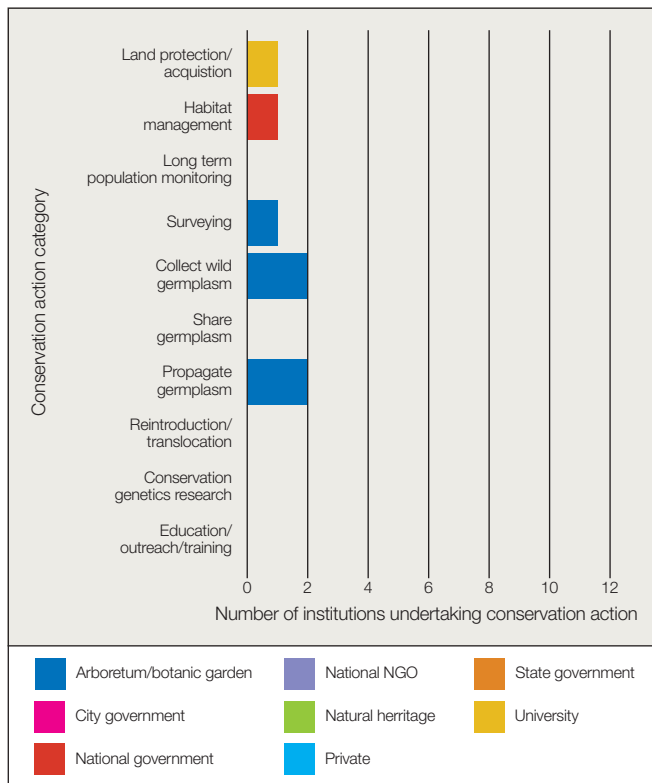


Figure 6. Number of institutions reporting conservation activities for *Quercus palmeri* grouped by organization type. Four of 252 institutions reported activities focused on *Q. palmeri* (see Appendix D for a list of all responding institutions).

Land protection: Within the inferred native range of *Q. palmeri* in the U.S., 65% of the land is covered by protected areas (Figure 7). These areas seem to provide a good amount of protection for Palmer oak, though key populations in California could be impacted by land development; fire suppression within protected areas may interfere with sexual regeneration of *Q. palmeri*, which is necessary to maintain a diverse population.

A small population of Palmer oak was discovered in Ventura County in 2002, potentially harboring unique genetics: “a new species of oak was found by City Staff in the Sunset Hills Open Space in the northeastern portion of the City...The population in our open space consists of about 6 trees approximately 20’ in height.”¹⁰ There is also one Candidate Special Interest Area—Garner Valley—within the San Bernardino National Forest, which hosts the most extensive actively reproducing subpopulation of *Q. palmeri* known in California (P. Manos pers. comm., 2018).^{11,12}

Sustainable management of land: The Garner Valley Hazardous Fuels Reduction Project was listed within the San Bernardino National Forest Schedule of Proposed Actions for early 2017: “The project would introduce fire to chaparral areas to create a mosaic of age classes and will reduce fuels in the project area.”¹² While searching for younger singleleaf pinyon trees, the Parry Pinyon Pine Protection Project found trees growing within a chaparral community

alongside frequent *Q. palmeri*. They found that some areas being treated for fuels have not burned in many decades, causing dense vegetation cover over three meters tall. Pinyon seedlings are doing very well, but the status of Palmer oak reproduction in the area is unknown.¹³

Population monitoring and/or occurrence surveys: During the 39th Annual Southern California Botanists Symposium in 2013, Lark Canyon and McCain Valley were toured by members of the San Diego chapter of the California Native Plants Society. Rainfall seemed to have been adequate in the region, compared to most of California that year, and healthy *Q. palmeri* were observed.¹⁴

Wild collecting and/or ex situ curation: Two institutions reported this activity in the conservation action questionnaire, but no other details are currently known.

Propagation and/or breeding programs: Two institutions reported this activity in the conservation action questionnaire, but no other details are currently known.

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

Research: In western Riverside County, California, a 2005 joint study between the California Department of Fish and Wildlife and the California Native Plant Society was established to define and describe the vegetation types present; their motivation was “to provide data for future management of the plant communities.” More than 2,000 kilometers squared of “core” undeveloped land has been classified and mapped, providing a baseline for management and conservation decisions in the future.⁸

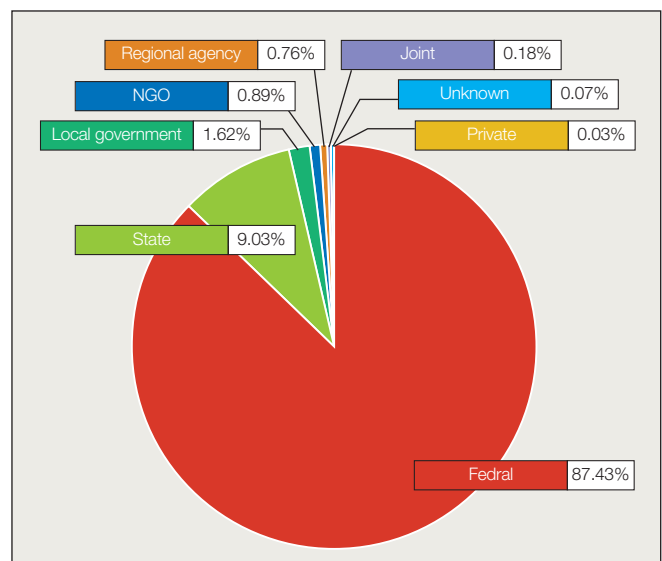


Figure 7. Management type of protected areas within the inferred native range of *Quercus palmeri*. Protected areas data from the U.S. Geological Survey Gap Analysis Program (GAP) 2016 Protected Areas Database of the U.S. (PAD-US).⁷

Education, outreach, and/or training: The Rare Plants of Santa Barbara County list was created to “bring attention to those vascular plant taxa with a limited distribution in Santa Barbara County, irrespective of their status, whether they are common elsewhere or whether they are considered imperiled, threatened, or endangered by resource management agencies.” The list was prepared from records maintained at the Santa Barbara Botanic Garden, and includes *Q. palmeri*.¹⁵ The California non-profit Sustainable Conservation recently produced a publication entitled Beyond Drought-Tolerant, which educates residents about native, low-water gardening. *Quercus palmeri* is among “a selection of western trees that have low-water needs.”¹⁶

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



PRIORITY CONSERVATION ACTIONS

Palmer oak consists of three main morphological groups: 1) populations in southern California as well as Baja California, Mexico; 2) populations in Arizona, and 3) putatively introgressed populations with *Q. chrysolepis* in New Mexico and eastern Arizona. The distinction between western and eastern populations of *Q. palmeri* is slight, and most apparent in leaf morphology, the latter with somewhat flatter and more deeply lobed leaves. Introgressed individuals are common in southeastern Arizona, and appear to have stronger affinities to *Q. chrysolepis* at the far eastern edge of its range. *In situ* conservation within California would begin with transplanting seedlings from proximal germplasm sources to several of the nearby populations known to harbor massive single clones. To better understand genetic and/or environmental effects on growth and development, *ex situ* efforts could include common garden experiments with germplasm representing the three morphological groups. Ideal locations would be botanical gardens in California and Arizona with conservation-based programs. Further representation of Palmer oak in *ex situ* collections should be pursued, since few of the species' wild populations are currently represented. Further effort should also be invested in population monitoring, including documenting losses to development or other land use changes as well as effects of fire suppression on *Q. palmeri* regeneration and overall ecosystem health within its habitat. It will be important to understand the ecosystem's appropriate disturbance regime, and use these data to inform sustainable land management practices in the future.

Conservation recommendations for *Quercus palmeri*

Highest Priority

- Reintroduction, reinforcement, and/or translocation
- Research (climate change modeling; land management/disturbance regime needs; population genetics; reproductive biology/regeneration; restoration protocols/guidelines)
- Wild collecting and/or *ex situ* curation

Recommended

- Population monitoring and/or occurrence surveys
- Sustainable management of land

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