Conservation Gap Analysis of Native

Mesoamerican Oaks

Species profile: ***Quercus acutifolia***

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CRITICALLY ENDANGERED

Quercus graciliformis
Quercus mulleri

ENDANGERED

Quercus brandegeei
Quercus carmenensis
Quercus cualensis
Quercus cupreata
Quercus delgadoana
Quercus devia
Quercus diversifolia
Quercus dumosa
Quercus engelmannii
Quercus flocculenta
Quercus galeanensis
Quercus hintonii
Quercus hirtifolia
Quercus insignis
Quercus macdougallii
Quercus miquihuanensis
Quercus nixoniana
Quercus radiata
Quercus runcinatifolia
Quercus tomentella

VULNERABLE

Quercus acutifolia
Quercus ajoensis
Quercus cedrosensis
Quercus costaricensis
Quercus gulielmi-treleasei
Quercus hintoniorum
Quercus meavei
Quercus rubramenta
Quercus tuitensis
Quercus vicentensis

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Quercus acutifolia Née

Synonyms: *Quercus anglohondurensis, Quercus conspersa, Quercus montserratensis, Quercus tenuiaristata*
Common Names, Spanish: Encino de asta, Encino blanco, Encino laurelillo, Encino pepitillo, Encino rojo, Encino saucillo, Encino tepezcohuite, Cabo de hacha, Sical, Huite, Bans

Species profile expert: Maura L. Quezada, University of San Carlos of Guatemala

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DISTRIBUTION AND BIOLOGY

Quercus acutifolia is distributed throughout central and southwestern Mexico in the states of Chiapas, Guerrero, Jalisco, México, Michoacán, Oaxaca and Veracruz. Its range also extends into Central America where it can be found in Guatemala and Honduras (Figure 1). In Mexico, *Q. acutifolia* inhabits the Sierra Madre del Sur and the Trans-Mexican Volcanic Belt at elevations between 1,000 and 2,500 m asl (Wenzell and Kenny, 2015). This species has been identified in 12 Holdridge life zones, the most common being subtropical moist forest (Figure 2). *Quercus acutifolia* grows in a variety of temperatures and semi-humid habitats, including pine-oak forest, tropical semideciduous forest, pine forest and oak forest (Valencia-A et al., 2015). In Guatemala, it is mainly distributed within the pine-oak ecosystem and oak forests, and its distribution ranges from 850 to 2600 m asl (Rodas Durate et al., 2018). *Quercus acutifolia* in Guatemala is a dominant and abundant species in forests, mainly dry, associated with other species of *Quercus* and in the group known as pine-oak. It has a high morphological variation which can generate confusion for its determination.


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There has been taxonomic uncertainty surrounding *Q. acutifolia*, and its nomenclature was recently revised. Based on review of herbarium specimens, type specimens, original descriptions as well as field work, Valencia-A et al. (2015) proposed *Q. conspersa* as a synonym of *Q. acutifolia*, and recognized *Q. grahamii* as the correct name for the taxon identified as *Q. acutifolia* sensu Trelease and Muller. A thorough review of herbarium specimens is needed to ensure that this change has been reflected in the records.

Quercus acutifolia is a large tree that typically reaches 10–40 m in height. Leaves are large and thick with dentate or entire margins. Leaves come in a variety of forms, ranging from obovate-elliptical with rounded bases to lanceolate with attenuated or cuneate bases (Pérez–Pedraza et al., 2021). One of the distinctive characteristics of *Q. acutifolia* is the fulvo-puberulent glabrous underside, with resinous hairs and tufts of stellate hairs in the axils of the secondary vein. The biennial fruit have an acorn cup with an involute margin (Rodas Duarte et al., 2018).

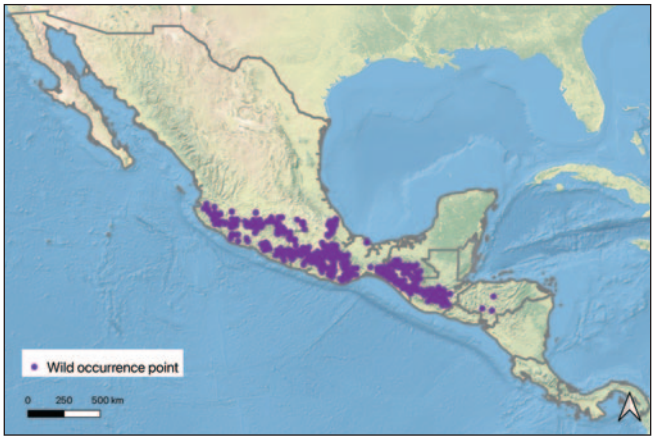

Figure 1. Wild (i.e., *in situ*) occurrence points for *Quercus acutifolia*.


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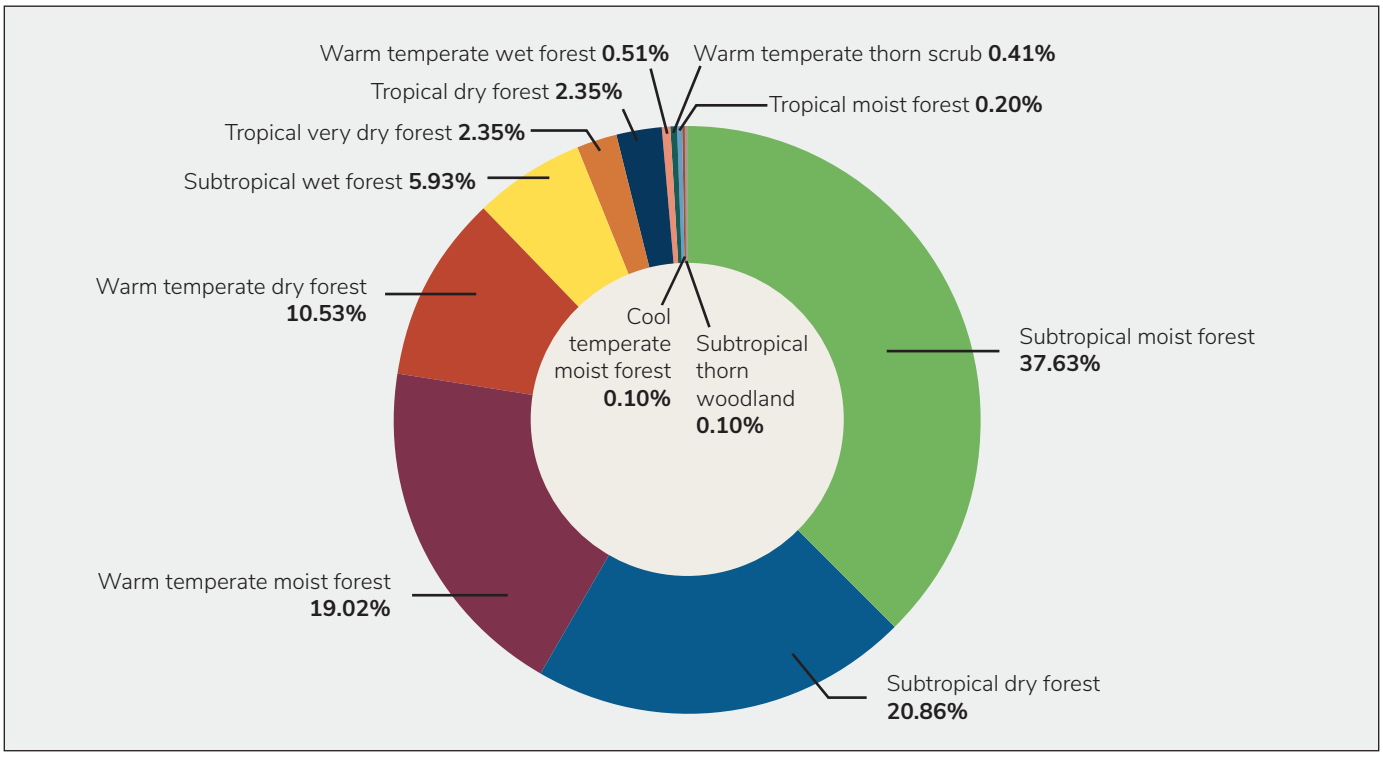

Figure 2. The percentage of wild occurrence points in each Holdridge life zone in which *Quercus acutifolia* is distributed.

THREATS TO WILD POPULATIONS

Human use of species — wild harvesting: In Guatemala, this species is highly appreciated for use in construction materials, such as fences. It is also used for the production of charcoal and firewood as an energy source for many rural communities.

Human use of landscape — agriculture, silviculture, ranching, and/or grazing: The temperate oak and pine-oak forests of Mexico and Central America where *Q. acutifolia* is found face high rates of deforestation and habitat destruction due primarily to commercial logging and clearing of land for agriculture and livestock grazing.

Human use of landscape — residential/commercial development, mining, and/or roads: The demographic growth of the last 30 years, at least in Guatemala, has increased pressure on wild forests, with pine-oak forests being the preferred ecosystems for human development.

Human use of landscape — tourism and/or recreation: In Guatemala, many popular recreation areas are close to pre-Columbian cities and are in the distribution of *Q. acutifolia*, which is why they are part of the landscape of many of the relics of the Mayan culture.

Human modification of natural systems — altered fire regime, pollution, eradication: The dry or semi-deciduous forests in which *Q. acutifolia* is distributed are vulnerable to forest fires, especially in degraded areas and bordering agricultural land. Due to the farming practice of slashing and burning, these fires can easily expand and threaten the species.

Human modification of natural systems — invasive species competition/disturbance: Unknown.

Climate change — habitat shifting, drought, temperature extremes, and/or flooding: In a study investigating the vulnerability of Mexican oaks to climate change, Gómez-Mendoza and Arriaga (2007) found that *Q. acutifolia* experienced range contractions of up to 41% under projections for 2050. There are a lack of studies on *Q. acutifolia* after the 2015 nomenclature revision. However, the impact of climate change is expected to be similar between *Q. grahamii* and *Q. acutifolia*. These two species live in similar ecosystems and should respond in a similar way.

Genetic material loss — inbreeding and/or introgression: In a study investigating hybridization between *Q. acutifolia* and *Q. grahamii*, researchers found that few individuals were F1 hybrids. However, 16% of the individuals studied showed evidence of introgression (Pérez-Pedraza et al., 2021).

Pests and/or pathogens: Unknown.

Extremely small and/or restricted population: This is not currently considered a threat.

CONSERVATION ACTIVITIES

Once per year between 2017 and 2022, *Quercus* accessions data were requested from *ex situ* collections globally. A total of 197 institutions from 27 countries submitted data for Mesoamerican oak species, including *Q. acutifolia* (Table 1, Figure 3). Past, present, and planned conservation activities for Mesoamerican oak species of concern were also examined through literature review and expert consultation.

Table 1. Results of 2017–2022 *ex situ* surveys.

Number of *ex situ* collections reporting this species	34
Number of plants in *ex situ* collections	91
Average number of plants per institution	3
Percent of *ex situ* plants of wild origin	37%
Percent of wild origin plants with known locality	50%

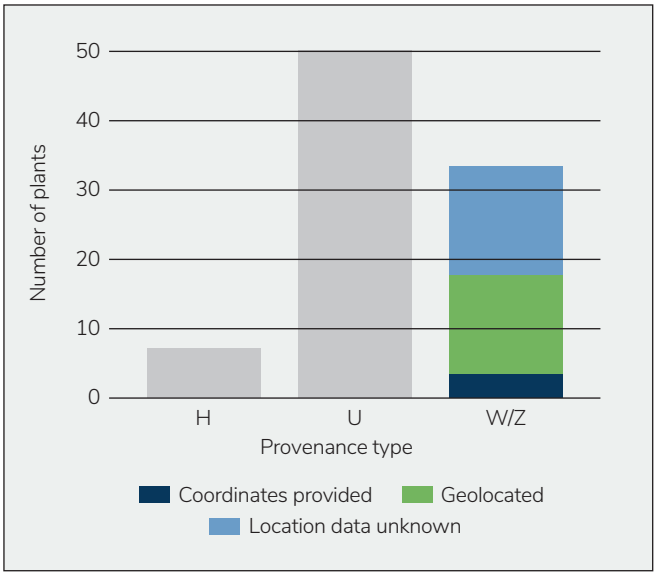

Figure 3. Number and origin of *Quercus acutifolia* plants in *ex situ* collections. Provenance types: H = horticultural; U = unknown; W = wild; Z = propagated from wild.

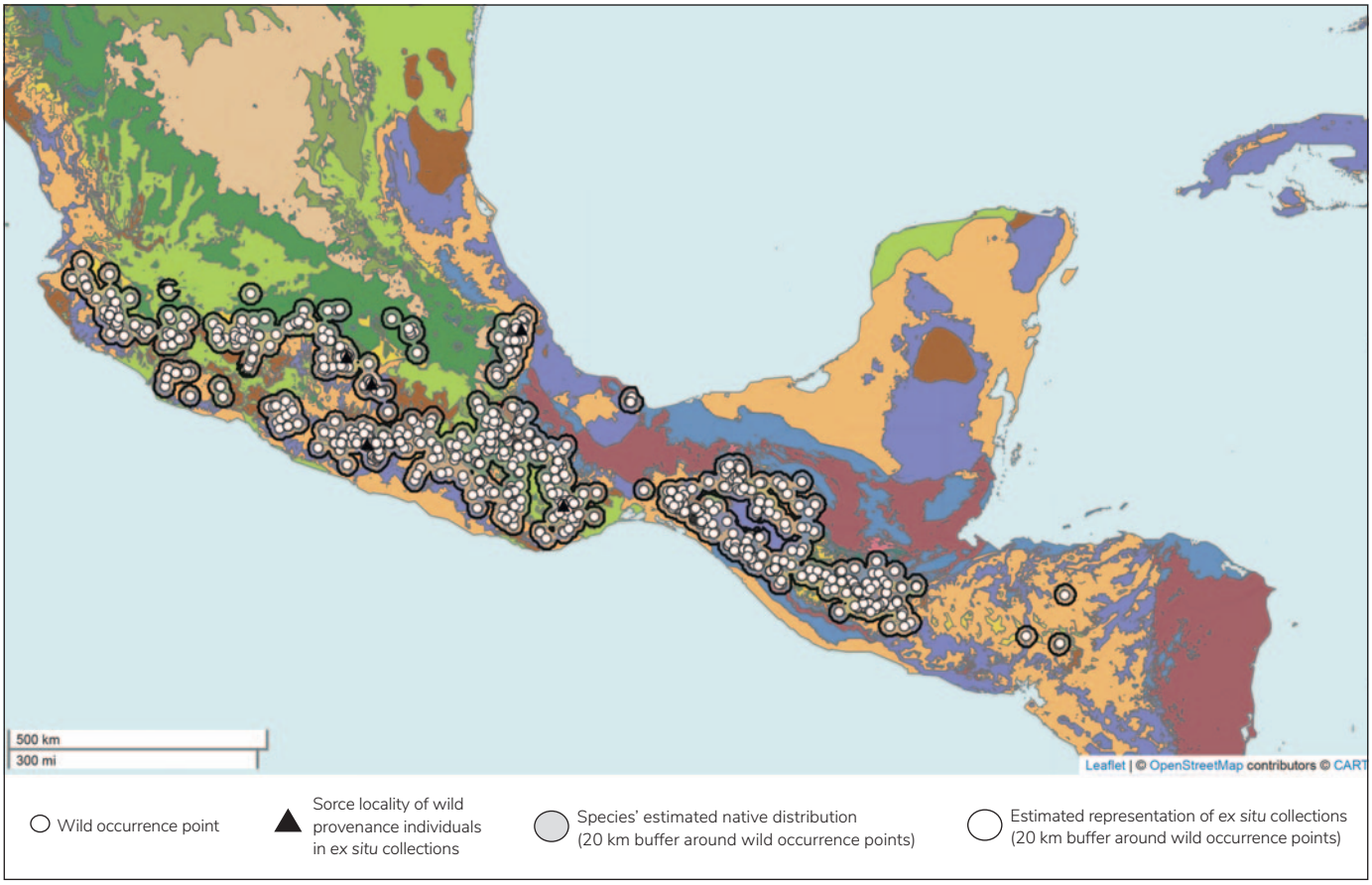

Figure 4. *Quercus acutifolia* wild occurrence points and ex *situ* collection source localities. Colored regions are Holdridge life zones. All ex *situ* collection source localities are also wild occurrence points.

Table 2. *Ex situ* conservation scores for *Quercus acutifolia* with all scores ranging from 0–100. A final score of 100 indicates comprehensive ex *situ* conservation, and a score of 0 represents poor ex *situ* conservation.

Geographic coverage ex *situ*	3
Ecological coverage ex *situ*	47
Representation in ex *situ* collections	100
Final ex *situ* conservation score	50

A spatial analysis was conducted to estimate the geographic and ecological coverage of ex *situ* collections using methods adapted from Khoury et al. (2020; Figure 4). Twenty-kilometer buffers were placed around each wild occurrence point as well as the source locality of each plant living in ex *situ* collections. Collectively, the buffer area around the wild occurrence points represents the inferred native range of the species. The buffer area around ex *situ* points serves as the native range represented in ex *situ* collections. Geographic coverage of ex situ collections was estimated by dividing the ex *situ* buffer area by the area of the inferred native range. Ecological coverage of ex *situ* collections was estimated by dividing the number of Holdridge life zones present under the ex *situ* buffer by the number of Holdridge life zones under the inferred native range. The species representativeness ex *situ* was calculated by counting the number of ex *situ* institutions that currently have one or more living individuals of wild provenance in their collections, up to a maximum of ten. In order to maintain a consistent scale across all scores, this number was multiplied by ten. All three scores range from 0–100. A final ex *situ* conservation score was calculated by taking an average of the three scores above. Final scores range from 0–100, with scores near 100 indicating comprehensive ex *situ* conservation, and scores near 0 indicating poor ex *situ* conservation (Table 2). As a reference, the threatened Mesoamerican oaks with the highest ex *situ* conservation scores are Q. *engelmannii* with a score of 76/100, and Q. *brandegeei* with a score of 74/100. There are 10 threatened oaks with final ex *situ* scores of 10 or less.

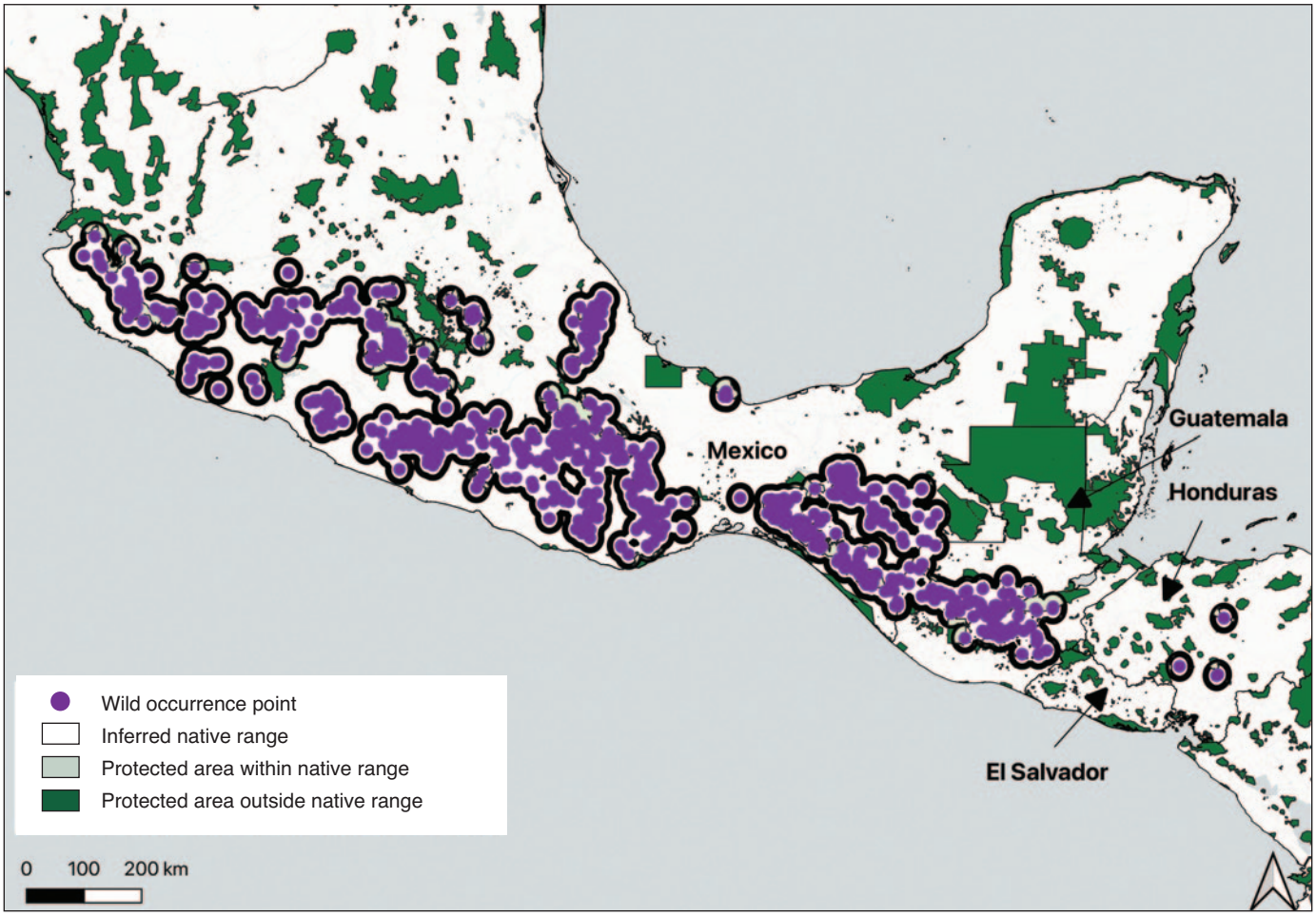

Figure 5. Wild occurrence points and inferred native range of *Quercus acutifolia* in relation to protected areas. Protected areas are from Protected Planet (UNEP-WCMC and IUCN, 2023.

Using methods adapted from Khoury et al. (2020), we estimated the degree of representation of *Q. acutifolia* in protected areas in order to identify *in situ* conservation gaps. Wild occurrence points were mapped and overlaid with protected areas from the World Database on Protected Areas (Figure 5; UNEP-WCMC and IUCN, 2023). A twenty-kilometer buffer was placed around each occurrence point to represent the species inferred native range. Geographic coverage *in situ* was estimated by calculating the proportion of a species inferred native range that is covered by protected areas. Ecological coverage *in situ* was estimated by identifying the Holdridge life zones in the inferred native range as well as the Holdridge life zones in protected areas within the inferred native range and calculating the percentage of life zones that are conserved in protected areas. Species representativeness *in situ* was estimated by calculating the percentage of known occurrence points within the species inferred native range that fall inside protected areas. All three scores range from 0–100. A final conservation score *in situ* was calculated by taking an average of the three scores above. Final scores range from 0–100, with scores near 100 indicating comprehensive in situ conservation, and scores near 0 indicating poor *in situ* conservation (Table 3). As a reference, the threatened Mesoamerican oaks with the highest *in situ* conservation scores are *Q. carmenensis* with a score of 99/100, and *Q. costaricensis* with a score of 94/100. There are two threatened oaks with final *in situ* scores of 10 or less.

Table 3. *In situ* conservation scores for *Quercus acutifolia* with all scores ranging from 0–100. A final score of 100 indicates comprehensive *in situ* conservation, and a score of 0 represents poor *in situ* conservation.

Geographic coverage *in situ*	11
Ecological coverage *in situ*	100
Species representation in *in situ* collections	19
Final *in situ* conservation score	43

Land protection: Within the inferred native range of *Q. acutifolia*, 11% is within protected areas (Figure 5).

Sustainable management of land: Currently, there are conservation programs dedicated to conserving and restoring forest landscapes in Guatemala (National Forest Landscape Restoration Strategy). This is an opportunity within the framework of this strategy to increase and recover anthropic landscapes with priority species, such as *Q. acutifolia*.

Population monitoring and/or occurrence surveys: This is not a conservation activity at the time of publication.

Wild collecting and/or *ex situ* curation: According to the results of our *ex situ* surveys, *Q. acutifolia* is currently held in 34 collections. Mexico is the source locality of all wild provenance individuals; there are no known collections originating from Guatemala or Honduras.

Propagation and/or breeding programs: This is not a known conservation activity at the time of publication. As part of a 2004 study investigating germination rates of *Q. acutifolia*, 900 acorns were sown in vermiculite and grown in a greenhouse (Rodriguez-Coombes et al., 2004). However, because this study took place before the taxonomic revision of *Q. acutifolia*, more research is needed to confirm these results.

Reintroduction, reinforcement, and/or translocation: This is not a known conservation activity at the time of publication. Two 2004 studies involved reintroduction of *Q. acutifolia* to Valsequillo Valley, Puebla State, Mexico (Rodriguez-Coombes et al., 2004) and forest fragments and agricultural land in Mexico (Alvarez-Aquino et al., 2004). These studies took place before the taxonomic revision of *Q. acutifolia*, and more work is needed.

Research: A recent study investigated the effect of hybridization on the interspecific differentiation of *Q. acutifolia* and *Q. grahamii* (Pérez Pedraza et al., 2021). There is also an effort underway in Guatemala to understand the morphological variability and different types of habitat, as well as strategies for the propagation of *Q. acutifolia* so that it is available for landscape restoration.

Education, outreach, and/or training: This is not a known conservation activity at the time of publication.

Species protection policies: There are no species protection policies for *Q. acutifolia*.


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PRIORITY CONSERVATION ACTIONS

In order to conserve *Q. acutifolia*, the conservation activities that should be given the highest priority are:

Education, outreach, and/or training

In order to preserve the forests in which *Q. acutifolia* is found, it is necessary to include the local community in conservation efforts and to provide educational material on *Q. acutifolia* and the threats faced by this species.

Propagation and/or breeding programs

Quercus acutifolia has great potential as a species to be used in reforestation. Propagation efforts should be supported so this species is available in nurseries to be used by both state and federal agencies in landscape restoration programs


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