



*QUERCUS BRANDEGEEI*  
CONSERVATION ACTION PLAN  
2025-2030

This plan follows the IUCN CPSG Principles and Steps



## Acknowledgments

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## Acronyms and Abbreviations

<b>(BGCI)</b>	Botanic Gardens Conservation International
<b>(CIBNOR)</b>	Centro de Investigaciones Biológicas del Noroeste
<b>(CONABIO)</b>	Comisión Nacional para el Conocimiento y Uso de la Biodiversidad
<b>(CONAFOR)</b>	Comisión Nacional Forestal
<b>(CONANP)</b>	Comisión Nacional de Áreas Naturales Protegidas
<b>(CPSG)</b>	Conservation Planning Specialist Group
<b>(GCCO)</b>	Global Conservation Consortium for Oak
<b>(IIES)</b>	Instituto de Investigaciones en Ecosistemas y Sustentabilidad
<b>(IUCN)</b>	International Union for Conservation of Nature
<b>(SEMARNAT)</b>	Secretaría de Medio Ambiente y Recursos Naturales

## In memoriam

This action plan is dedicated to the memory of Dr. Aurora M. Breceda Solís-Cámara, whose passion for ecology, conservation, and supporting the identity of the “rancheros subcalifornianos” inspired and guided the creation of this action plan.



*A great soul never dies, and yours lives in our hearts and in the Sierra La Laguna, forever*

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# CONTENTS

<b>Executive Summary</b> .....	<b>4</b>
<b>Introduction</b> .....	<b>5</b>
The Importance of Oaks .....	5
Species Name and Description .....	6
Eco-Geographical Information .....	6
Ecological and Economic Importance .....	7
Conservation Status .....	7
<b>Research and Knowledge Summary/Gaps</b> .....	<b>8</b>
<b>Threats and their Drivers</b> .....	<b>11</b>
<b>Past and Current Conservation Actions</b> .....	<b>13</b>
<b>Strategy for Conservation</b> .....	<b>15</b>
Vision .....	16
Actions .....	17
<b>Next Steps</b> .....	<b>22</b>
<b>References</b> .....	<b>23</b>
<b>Appendix A</b> .....	<b>24</b>



Action Planning team at the 2021 workshop in the community of San Dionisio, Sierra La Laguna Biosphere Reserve, Baja California Sur, Mexico. Back row from left to right: Sean Hoban, Antonio Gonzalez-Rodriguez, Daniel Perez Morales, and Matthew Taylor. Front row: Christine Klimas, Silvia Alvarez-Clare, Fanny Reyes, and Aurora Breceda Solís. Not photographed: Abelino Cota, Christian Silva, and Mariana Fuentes. (The Morton Arboretum)



# EXECUTIVE SUMMARY



Community workshop on *Q. brandegeei* conservation in the Community of San Dionisio, Baja California Sur. (The Morton Arboretum)

*Quercus brandegeei* is classified as Endangered (EN) according to the IUCN Red List, primarily due to its lack of regeneration and restricted distribution in the state of Baja California Sur, Mexico. It is also one of the 32 threatened species highlighted in the Conservation Gap Analysis of Native Mesoamerican Oaks and a priority species for the Mesoamerican region of the Global Conservation Consortium for Oak (GCCO). Since 2016, a transdisciplinary team from multiple sectors has worked together to collect genetic, phenological, and ecological data on *Q. brandegeei* to determine specific threats and identify conservation and management needs. In October 2021, a two-day workshop and a symposium were held in the community of San Dionisio, Baja California Sur in order to effectively plan conservation action for *Q. brandegeei*. Fifty participants from a variety of sectors including government, academia, arboreta, and

community members were in attendance. This action plan summarizes the results of the conservation planning workshop and symposium.

In this conservation action plan, we propose priority conservation actions for this high-risk species and identify ways in which we can work together at the national level through the established GCCO network. This plan identifies four primary goals for effective conservation over a five-year timeframe centered around monitoring, protected area management, education campaigns, and research. Specific actions and indicators of success are identified for each goal. This plan covers the entire range of *Q. brandegeei* and was developed in collaboration with stakeholders from a variety of sectors. It is open to feedback from other contributors who did not participate in the conservation action plan workshops.

# INTRODUCTION

## The Importance of Oaks

The genus *Quercus* is very diverse, and includes around 450 species worldwide. The center of oak diversity is in Mexico, where there are an estimated 160 species. Many of these species exhibit a great degree of hybridization, giving rise to high variation, accelerated radiation, adaptation to new habitats, and diversification. This, coupled with a complicated taxonomy, make oaks a “model system” to understand evolutionary, biogeographical, and ecological aspects in plants. Oak species represent one of the most successful woody plants in the temperate forests of the Northern Hemisphere.

In Mexico and Central America, oaks are used as a source of firewood and charcoal. The bark is used for medicinal purposes, and acorns are used for human consumption, feeding domestic animals, and producing handicrafts. Tannins for tanning and pigments for dyeing are also obtained from oaks. Oaks can be found on the flags of many nations, and they hold cultural and religious value for people around the world. Although oaks have great ecological, economic and cultural importance, many oak species are threatened with extinction. Climate change and habitat loss due to agriculture and urban and rural development are the greatest threats to oaks in Mexico.

According to the International Union for Conservation of Nature (IUCN) Red List of Threatened Species, there are 32 species of oak assessed as threatened in Mexico. In addition, 27 species of Mexican oak are categorized as Data Deficient (DD), meaning that there is inadequate information to assess their extinction risk. Threatened and DD species require research and conservation action to ensure that they not only survive, but are resilient to the threats they face now and in the future. This requires protection of wild populations in their natural habitats (i.e. *in situ* conservation), as well

as in botanic gardens and seed banks (i.e. *ex situ* conservation). Oaks are recalcitrant species, meaning their acorns do not survive the low temperature and humidity conditions of a standard seed bank. These “exceptional species” require alternative methods for effective *ex situ* conservation of genetic diversity.

Given the large, global distribution of oaks and their many threats, the Global Conservation Consortium for Oak (GCCO), which falls under Botanic Gardens Conservation International (BGCI), was launched to coordinate a network of institutions and experts to collaboratively implement comprehensive conservation strategies to prevent extinction of the world’s oak species. The GCCO is led by The Morton Arboretum and has successfully established the network in the US, Mexico, Central America, China, Southeast Asia, and recently Europe, West Asia, and North Africa.



*Quercus brandegeei* leaves and acorns.  
(The Morton Arboretum)

## Species Name and Description

**Species name:** *Quercus brandegeei* (Goldman, 1916)

**Synonyms:** N/A

**Common names:** Encino arroyero (arroyo oak), Encino bellotero

### Description:

*Quercus brandegeei* is a medium-sized evergreen oak. The trunk is moderate to large with a height between 18–20 m, with gray furrowed bark and a wide, extended crown that can measure 20 m<sup>2</sup> on average. It presents a type of anemophilous pollination, in which the male and female flowers appear in separate inflorescence (monoecious) in the months of March and April. The male flowers are arranged in hanging catkins and the female flowers are solitary or in groups of two or three. In this species, a mainly annual fruit ripening cycle has been observed, completing ripening in autumn and winter. *Quercus brandegeei* alternates between producing abundant and scarce acorns, or even no production at all. It presents great polymorphism in both



*Quercus brandegeei* flowering. (Daniel W. Pérez)

the leaves and its fruits, with differences primarily in shape, coloration and dimensions. The acorns measure 3–4.5 cm long by 1–1.2 cm wide, and are fusiform. The large, elliptical, usually smooth-margined leaves are 4–6.5 cm long by 1–2 cm wide and are acute at the tip (Muller, 1961; Cavender-Bares et al., 2015; Pérez-Morales, 2021).



**Figure 1:** Map of the known populations of *Quercus brandegeei* in Baja California Sur. (Brinckwirth et al., 2023)

## Eco-geographical Information

*Quercus brandegeei* is endemic to the state of Baja California Sur, Mexico (Fig. 1). It is distributed in the area known as the Cape Region (approximately 8,500 km<sup>2</sup>). The climate types in the Cape Region are dry and temperate subhumid in the high mountain areas. The rainy season is mainly in summer, during the months of August to October. Hurricanes are one of the main sources of precipitation, which varies between 100–600 mm annually (Coria, 1988; González et al., 2010).

One of the characteristic features of the physiography of the region is the Sierra de la Laguna, a mountain range that runs from north to south with a maximum altitude of 2,100 meters. Different types of ecosystems occur along an altitudinal gradient. At low to mid elevations there is scrub vegetation and the only deciduous lowland forest (tropical dry forest) in the peninsula. At high elevations, oak forest and pine oak forests can be found. There is also riparian vegetation, which is a system of plant communities that are located along the main canyons. The populations of *Q. brandegeei* are limited to patches on the banks of these rivers and streams, at altitudes no higher than 800 m.

## Ecological and Economic Importance

As is the case with most *Quercus*, this species is of great ecological importance for the fauna of the region. Its trunks provide shelter for wild animals, its leafy crown provides shade, and its acorns are consumed by a variety of animals, such as rodents (rats and mice), birds, insects, and domestic animals (pigs, goats and cows). Due to its distribution along seasonal stream banks, *Q. brandegeei* stabilizes soil and prevents erosion during hurricanes or heavy rains. This species generates leaf litter and is characterized by having a “sprout carpet” at the base, creating a soil with more organic matter and potentially capturing nutrients that would otherwise be washed into the sandy soil of this region (CONANP, 2003). The ecological benefit of this “ground cover” for *Q. brandegeei* and other oak species is unknown.

The encino arroyero is highly valued by residents. The wood is used for firewood and the production of crafts and tools. It is an important food source for ranch pigs and cattle, as well as a source of shade. Acorns can be prepared in the form of the milky beverage “atole,” flour, and oil. It is also a species with high cultural and aesthetic significance that stands out in the middle of the xeric scrub (León de la Luz et al., 2014; Pérez-Morales, 2021).



*Quercus brandegeei* seeds. (José L. León de la Luz)



Clean and cut acorns to toast and prepare into “atole.” (The Morton Arboretum)

## Conservation status

*Quercus brandegeei* is classified as an Endangered (EN) species under criterion B1ab(iii,v)c(iv)+2ab(iii,v)c(iv) according to the IUCN Red List (Denvir and Westwood, 2016) and the Red List of Oaks (Carrero et al., 2020). This threat category is based on the small area of occupancy (AOO = 104 km<sup>2</sup>) and extent of occurrence (EOO = 1,660–3,052 km<sup>2</sup>) as well as the small number of populations and lack of natural regeneration (Denvir and Westwood, 2016). The Green Status assessment of *Q. brandegeei* indicates that this species is largely depleted, but with continued conservation efforts the recovery potential is high (Alvarez-Clare et al., 2021).



Young seedlings (~1 yr old) of *Quercus brandegeei* at Señor Refugio’s home nursery in Santiago, Baja California Sur, Mexico. (The Morton Arboretum)





# RESEARCH AND KNOWLEDGE SUMMARY/GAPS



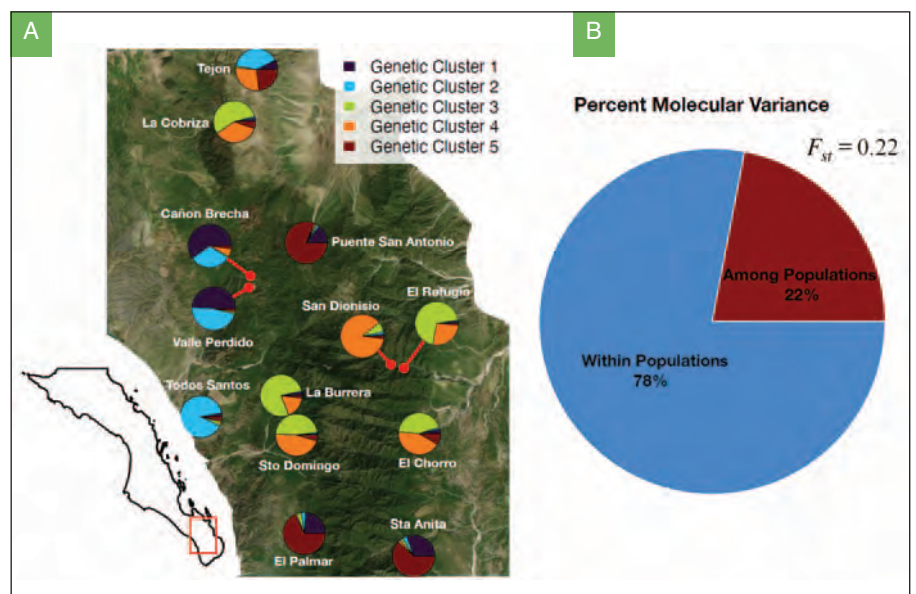
*Quercus brandegeei* in its habitat near to the river bank in San Dionisio canyon, Baja California Sur. (The Morton Arboretum)

**Phylogeny:** Cavender-Bares et al. (2015) generated a calibrated phylogeny of the American live oak's clade (*Quercus* section *Virentes*), which are distributed in the temperate and tropical regions of North America and Mesoamerica (Nixon and Muller, 1997; Manos et al., 1999; Cavender-Bares et al., 2011). Using RADseq data to estimate divergence times along with nuclear microsatellites, they examined genetic diversity within

species, rates of gene flow between species, and the ancestral population size of separate sister species. According to this study, *Q. brandegeei* and *Q. fusiformis* form a clade that is the sister group of the rest of the *Virentes* species, which in turn is congruent with the more western geographical distribution of these two species. Microsatellites indicated that *Q. brandegeei* is genetically distinct, while chloroplast sequences revealed that the species harbors a unique chloroplast haplotype that is one mutation away from an ancestral haplotype that is widespread within *Virentes* and is also found within *Q. fusiformis*.

More detailed studies of the intraspecific genetic variation of *Q. brandegeei* indicate that the species has been subjected to significant processes of genetic drift, as can be interpreted from the comparatively low levels of genetic diversity (Fig. 2a) and high differentiation between populations (González-Rodríguez et al. in prep; Fig. 2b). Clonal propagation also seems to have played an important role in the permanence of the species, since several individuals with identical genotypes were identified.

**Figure 2:** Genetic structure in *Quercus brandegeei*: a) geographic distribution of the five genetic groups identified by nuclear microsatellites and a genetic cluster analysis, and b) the percentage of genetic variation found within and between populations.  $F_{ST}$  is Wright's fixation index, which indicates that 22% of the genetic variation corresponds to differences between populations. This value is higher than the values generally found in oak species, which may be due to limited gene flow between populations and the action of genetic drift, promoted by reduced population sizes. (González-Rodríguez et al. in prep)



According to González-Rodríguez et al. (in prep), the ancestral populations of *Q. brandegeei* and *Q. fusiformis* were at least 30 times larger than current estimates for the populations of both species combined. The isolation with migration model also shows very clear evidence of range retraction, probably due to long-term climate change. Evidence from lack of recruitment suggests that population size could decline significantly within the next generation, although the extent of that decline is unknown (Cavender-Bares et al., 2015).

Brinckwirth et al. (2023) evaluated the spatial aggregation pattern and the factors that determine acorn production of *Q. brandegeei*. They hypothesized that there would be greater aggregation in regions with greater precipitation and that acorn production will depend on individual attributes of the parent trees and of climatic variables. The analysis showed that individuals are highly aggregated, with the greatest aggregation being observed at distances of 0–25 m. The presence of acorns depended more on the geographic region than on climatic variables. The high aggregation and low evidence of acorn production in some populations suggests that there is a niche reduction for *Q. brandegeei*, which is confined to very specific microsites along ephemeral riverbeds. Suitable recruitment areas could be further reduced with the warmer and drier climate predicted for the region.



Local farmer transplanting seedlings for the enclosure experiment. (The Morton Arboretum)



Seedling transplantation and data collection to test the effects of animal grazing on seedling survival and growth. (The Morton Arboretum)

**Consumption by domestic animals:** In 2019, an experiment was established to evaluate the mortality of 700 *Q. brandegeei* seedlings. The experiment was established in the community of San Dionisio within the Sierra La Laguna Biosphere Reserve. Seedlings were transplanted inside and outside of fenced enclosures and with and without canopy cover from *Q. brandegeei* adults. A camera trap was installed at each site to quantify the intensity and frequency of mammal activity. Seedlings transplanted outside the enclosures had higher mortality, regardless of the site's canopy openness. For seedlings within the enclosures, the mortality rate was 2.6% higher on average at sites with open canopy than at sites with canopy cover. Seedlings had significantly lower mortality when there was no drying, and they were shaded by the canopy. At the end of the study (day 356), trees in the open environment had significantly higher mortality than those growing in the shade (Alvarez-Clare et al., in prep).

As expected, evidence of grazing was significantly lower within the enclosures, confirming that the removed seedling parts and tissues were caused by grazing and trampling by domestic animals. Cows, goats, and pigs were recorded regularly grazing or trampling seedlings. Seedlings transplanted to open sites had significantly more drying than those in shaded sites on day 120 and at the end of the study on day 356. After a year, almost all the transplanted seedlings (624 of 700 seedlings initially planted) were dead or gone, revealing the extremely harsh conditions that *Q. brandegeei* seedlings face, at least when grown near ranches.

**Risk of desiccation and climate change:** For the Baja California peninsula, an increase in aridity is expected with a reduction in winter-spring rainfall in the north and summer rainfall in the center and south (Cavazos and Arriaga-Ramírez, 2012). In the short term, these climate projections may lead to a decrease in acorn production, and in the long term, this may increase the interval between acorn years (Brinckwirth et al., 2023). Regardless of the exact mechanism that is preventing the natural regeneration of the species, habitat loss caused by the desiccation of the ephemeral channels of the region's streams remains a major threat.

Researchers have proposed that desiccation of ephemeral channels could be caused by long-term climate change (Cavender-Bares et al., 2015; Alvarez-

Clare and León de la Luz, personal communication). Other studies modeling climate change predictions for Mexico corroborate this theory by predicting a reduction in precipitation in southern Baja California caused by global warming (Cavazos and Arriaga-Ramírez, 2012). More research is needed on the effects that drought and climate change will have on this type of habitat.

There are still several gaps in our knowledge of this species. For example, the population size is unknown. We need more information on how to improve propagation, as survival has been very low in the field. We also do not fully understand the ecology of the acorn and the species that depend on it, and a better understanding of the socioeconomic value and horticultural potential of the species is required.



*Quercus brandegeei* (Victor Garcia Balderas)

# THREATS AND THEIR DRIVERS

Research conducted by The Morton Arboretum, CIBNOR, and others have confirmed and expanded on the threats described in the Red List assessment for *Q. brandegeei* (Table 1). Three threats emerged as the most pressing after the participatory workshop and a subsequent workshop with experts:

## 1. Inherent small populations and relict habitat

Similar to other wildlife species in the Sierra La Laguna area, *Q. brandegeei* is a relict species that failed to adapt to the dry and hot conditions of the Cape after the Sea of Cortez was formed 4–5 million years ago. Its remaining habitat is extremely small, restricted to the banks of the ephemeral arroyos in the base of the mountain range. Field surveys prior to 1998 and again in 2015 reported no regeneration for the species at several sites, and researchers observed no trees younger than 100 years in the field. Declining habitat quality caused by desiccation of ephemeral river channels is thought to be the cause of the complete lack of regeneration over the past 100 years, and as a result, population declines and extreme fluctuations in the number of mature individuals are projected for the future (Cavender-Bares et al. 2015; Brinkwirth et al. 2023).

## 2. Consumption of acorns by domestic animals

A study conducted by Alvarez-Clare et al. (in prep), as well as observations shared by stakeholders during the 2021 conservation action workshop, confirmed that acorn consumption by livestock (cows, pigs, and goats) is a major issue for regeneration of this species. Goats and cows also graze on seedlings and trample young trees when they use adult trees for shade. Because most of the ranches occur along the arroyos, which is the habitat for *Q. brandegeei*, livestock have a direct impact on the species. There is currently almost no regeneration for this species and no juveniles.

## 3. Increased seedling and adult mortality due to climate change anomalies

Increases in hurricane and tropical storm strength and frequency result in intense rainfall in the mountains, which cause severe floods and strong currents along the arroyos. These floods can uproot or damage adult trees growing along the banks. Workshop participants mentioned having observed a higher rate of adult tree mortality in recent years. This is consistent with the scientific data on storms and weather for the Cape Region. High temperature extremes in the summer have also shown to be detrimental to young seedling establishment (Alvarez-Clare et al. in prep).

Other potential threats that were discussed during the conservation action workshop are exploitation of mining and construction materials, little to no regulation surrounding recreational activities, lack of environmental awareness, residential/commercial development, and tourism/recreational activities. More research is required to determine the intensity and impact of these potential threats.



Consumption of *Q. brandegeei* acorns by livestock. (The Morton Arboretum)

**Table 1.** Classification and hierarchy of threats to *Quercus brandegeei* and their degree of impact based on the IUCN threats classification scheme.

THREAT CLASSIFICATION	TIMING			IMPACT
	THREAT	PAST	CURRENT	FUTURE
<b>Residential and commercial development</b> <ul style="list-style-type: none"> <li>• Tourism and recreation areas</li> </ul>	✓	✓	✓	Unknown
<b>Agriculture and aquaculture</b> <ul style="list-style-type: none"> <li>• Small-scale agriculture</li> <li>• Livestock and grazing</li> </ul>	✓	✓	✓	Affects most of the population (50-90%)
<b>Energy production and mining</b> <ul style="list-style-type: none"> <li>• Mining and quarrying (extraction of material from streams for construction)</li> </ul>	✓	✓	✓	Affects the minority of the population (<50%)
<b>Use of biological resources</b> <ul style="list-style-type: none"> <li>• Acorn collection for intentional use</li> <li>• Logging and wood extraction</li> </ul>	✓	✓	✓	Affects most of the population (50-90%)
<b>Intrusions and human disturbances</b> <ul style="list-style-type: none"> <li>• Lack of environmental education and regulation of recreational activities</li> </ul>			✓	Affects the minority of the population (<50%)
<b>Modifications of the natural system</b> <ul style="list-style-type: none"> <li>• Potential fires</li> <li>• Water management and use: over-extraction of groundwater</li> </ul>		✓	✓	Affects most of the population (50-90%)
<b>Invasive species and other problem species</b> <ul style="list-style-type: none"> <li>• The German carnation (<i>Cryptostegia grandiflora</i>), an invasive parasitic species</li> <li>• Feral pig (<i>Sus scrofa</i>)</li> </ul>	✓	✓	✓	Affects most of the population (50-90%)
<b>Climate change and severe weather</b> <ul style="list-style-type: none"> <li>• Habitat change and alteration</li> <li>• Droughts</li> <li>• Extreme temperatures</li> <li>• Storms and flooding</li> </ul>	✓	✓	✓	Affects most of the population (50-90%)

# PAST AND CURRENT CONSERVATION ACTIONS

Conservation activities that impact *Q. brandegeei* and its habitat date back to 1994, with the decree of the Sierra La Laguna Biosphere Reserve. Since then, several species-specific conservation activities have taken place, such as education and awareness, site

management, propagation, and research (Table 2). A variety of sectors, including academia, government, botanic gardens, research institutions, and the local community play a crucial role in the conservation of this species.

**Table 2.** Past (since 1994) and current conservation actions for *Quercus brandegeei*. Categories of actions are based on the IUCN Red List of Threatened Species.

CONSERVATION ACTIONS	RESPONSIBLE PARTY	ACTION DATE
<b>Land/water protection</b> <ul style="list-style-type: none"> <li>• Site/area protection</li> <li>• Protection of resources and habitats</li> </ul>	Federal Government-SEMARNAT	<b>1994:</b> Decree of the Sierra La Laguna Biosphere Reserve. (Note: The Sierra La Laguna Biosphere Reserve program has not been updated since 1994)
<b>Land/water management</b> <ul style="list-style-type: none"> <li>• Site/area management</li> <li>• Species control</li> <li>• Restoration of habitats and natural processes</li> </ul>	Federal Government-SEMARNAT, CONANP, CIBNOR, community	<b>2007-2012:</b> Work to control <i>Cryptostegia grandiflora</i> . More work is needed. <b>2007:</b> Work to control feral pigs ( <i>Sus scrofa</i> ). More work is needed.
<b>Species recovery</b> <ul style="list-style-type: none"> <li>• Species reintroduction</li> <li>• Ex situ conservation</li> </ul>	The Morton Arboretum, CIBNOR, CONANP, botanical gardens, community	<b>2018-2023:</b> Conservation of genetic diversity in 10 botanical gardens. <b>2021:</b> Start of the “Salvemos al encino arroyero” tree adoption program. Program continues as of 2025. <b>2022:</b> CLP-CIBNOR-Morton team conservation project focused on preparing a multi-criteria analysis to prioritize conservation areas. <b>2023:</b> The draft Action and Management Plan for the species developed but not published.

Table 2. Continued

CONSERVATION ACTIONS	RESPONSIBLE PARTY	ACTION DATE
<p><b>Education and Awareness</b></p> <ul style="list-style-type: none"> <li>• Dissemination and training</li> <li>• Awareness and communications</li> </ul>	<p>The Morton Arboretum, CIBNOR, UNAM, CONANP</p>	<p><b>2017:</b> First Morton Arboretum-led field work to find trees and assess population status.</p> <p><b>2019:</b> Research, propagation, interviews with the community as part of Franklinia project through Global Trees Campaign grant to BGCI.</p> <p><b>2021:</b> Production of documentary film of the project “Salvemos al Encino Arroyero”.</p> <p><b>2021:</b> Conservation Action Planning-Community Workshop in San Dionisio and <i>Quercus brandegeei</i> Conservation Symposium in La Paz.</p> <p><b>2022:</b> First Arroyo Oak Conservation Festival in San Dionisio.</p> <p><b>2023:</b> Second Arroyo Oak Conservation Festival in San Dionisio.</p>
<p><b>Law and Policy</b></p> <ul style="list-style-type: none"> <li>• Legislation, National Level</li> <li>• Policies and regulations</li> </ul>	<p>Federal Government-SEMARNAT, CONANP</p>	<p><b>2022:</b> Explored the possibility of including the species in NOM-059-SEMARNAT-2010. Team did not follow through.</p>
<p><b>Livelihood, economic, and other incentives</b></p> <ul style="list-style-type: none"> <li>• Conservation payments</li> </ul>	<p>Federal Government-SEMARNAT, CONANP, CIBNOR, The Morton Arboretum</p>	<p><b>2021:</b> Explore potential projects to promote sustainable use of the species and alternatives to its economic exploitation. This project was not funded or executed.</p>

# STRATEGY FOR CONSERVATION

The conservation strategy for *Q. brandegeei* is based on conservation actions recommended in the IUCN Red List assessment, as well as information collected in interviews, workshops, and roundtables. It is adapted to the specific characteristics of the Cape Region and *Q. brandegeei*. In October 2021, a workshop and a symposium on the conservation of *Q. brandegeei* was held in the community of San Dionisio, which is located within the Protected Natural Area Sierra La Laguna Biosphere Reserve. A total of 50 participants attended both events. The workshop and the symposium were conducted with the purpose of sharing knowledge between the community and local and international researchers. Participants brought together their unique experiences and perspectives to identify threats and potential recovery actions, as well as responsible parties. For a list of participants, see Appendix A.



Community workshop on the conservation of *Q. brandegeei* in San Dionisio, Baja California Sur. (The Morton Arboretum)



Identification of threats, conservation actions, and commitments for the conservation of the species at the First Conservation Symposium of *Q. brandegeei* in La Paz, Baja California Sur. (The Morton Arboretum)



Knowledge exchange at the community workshop on *Q. brandegeei* conservation in San Dionisio, Baja California Sur. (Christie Klimas)



## VISION

By 2030, *Q. brandegeei* populations are mapped, monitored, and sustainably managed by developing and executing data-driven protection and restoration actions in coordination and collaboration with local communities and other key stakeholders.

## GOALS

These four goals outline the broad themes for conservation of *Quercus brandegeei* over the next 5 years.

### **Goal 1:**

Develop and execute research that supports a greater understanding of the threats facing *Q. brandegeei* and provides the information needed for its conservation.

### **Goal 2:**

Improve the quality of *Q. brandegeei*'s habitat while supporting sustainable livelihoods within its range by working hand-in-hand with protected area managers and other stakeholders.

### **Goal 3:**

Implement direct actions that result in recovered *Q. brandegeei* populations in its native range, as well as promote botanical living collections as an insurance policy against extinction.

### **Goal 4:**

Have informed and empowered stakeholders and community members in the Cape Region, who support *Q. brandegeei* through knowledge sharing, support of policy, participation in communal activities, and engagement in environmental education programs.

## Actions

### ACTION #1

#### GOAL:

Develop and execute research that supports a greater understanding of the threats facing *Q. brandegeei* and provides the information needed for its conservation.

#### RATIONALE:

Research and monitoring are of vital importance to develop a successful strategy to recover and manage any species. In the case of *Q. brandegeei*, there are still important knowledge gaps that need to be addressed to make informed and accurate decisions for its conservation.

OBJECTIVES	ACTIONS	INDICATORS OF SUCCESS
1) Improve understanding of population genetics and genetic connectivity among populations.	a. Identify differences between populations in terms of their genetic diversity and the viability of their populations.	<ul style="list-style-type: none"> <li>• Paper published on population genetics and connectivity among species.</li> </ul>
2) Improve understanding of <i>Q. brandegeei</i> habitat.	a. Conduct floristic surveys. b. Identify the degree of disturbance of the patches where the species is established. c. Determine the areas in need of recovery actions.	<ul style="list-style-type: none"> <li>• Information on the state of fragmentation of the forest remnants where the species occurs.</li> <li>• Updated floristic survey of Sierra La Laguna.</li> </ul>
3) Assess the age, size, structure, and viability of remaining populations.	a. Create a population structure model to determine viability of the remaining populations. b. Evaluate acorn viability through laboratory and greenhouse experiments. c. Study the phenology and productivity of the species.	<ul style="list-style-type: none"> <li>• Information analyzed from the viability estimates of the species' populations in the region.</li> <li>• Article on the phenology of the species and manual or propagation methods.</li> </ul>
4) Establish monitoring protocols for <i>Q. brandegeei</i> populations.	a. Monitoring of population productivity. b. Study potential effects of climate change on the populations of the species.	<ul style="list-style-type: none"> <li>• Species monitoring methodology.</li> <li>• Paper on the effect of droughts and floods on populations.</li> </ul>

**Responsible Parties and Collaborators:** CIBNOR, The Morton Arboretum, IIES-UNAM, CONANP - REBIOSLA. More collaborators needed.



## ACTION #2

### GOAL:

Improve the quality of *Q. brandegeei*'s habitat while supporting sustainable livelihoods within its range by working hand-in-hand with protected area managers and other stakeholders.

### RATIONALE:

Most of the remaining populations of *Q. brandegeei* are located in protected areas (PA). However, the presence of livestock in these reserves poses a direct threat to seedling regeneration and population recovery. Invasive species such as *Cryptostegia grandiflora* also pose a significant threat, both inside and outside PAs. We propose to work with land managers to develop and implement innovative measures that reduce the impact on *Q. brandegeei* populations while also considering the needs of the local ranchers and other community members. There is a need to better understand ethnobotanical uses and explore potential commercial uses of the species.

OBJECTIVES	ACTIONS	INDICATORS OF SUCCESS
<p>1) Raise awareness among local stakeholders inside and near the PA regarding the ecosystem services provided by <i>Q. brandegeei</i>.</p>	<p>a. Promote local traditions and knowledge for the use and conservation of the species.</p> <p>b. Quantify through an ecological/economical model the benefits provided by the species to local inhabitants.</p> <p>c. Work with local NGOs to include <i>Q. brandegeei</i> in existing outreach programs.</p>	<ul style="list-style-type: none"> <li>• Number of people aware of the benefits of <i>Q. brandegeei</i> and participating in outreach programs within the PA.</li> <li>• Ecological/economical model published.</li> </ul>
<p>2) Strengthen the legal instruments that regulate the proper management of the species and promote its uses, exploitation and services sustainably.</p>	<p>a. Work with PA managers to develop low livestock safe sites within the PA.</p> <p>b. Create exclosures with no livestock within the PA.</p> <p>c. Include management measures in the next work plan for the Sierra La Laguna Biosphere Reserve.</p> <p>d. Explore the possibility of including <i>Q. brandegeei</i> as a priority species (NOM-059 SEMARNAT-2010).</p> <p>e. Include <i>Q. brandegeei</i> as a trigger species for existing Key Biodiversity Areas (KBAs) in the region.</p>	<ul style="list-style-type: none"> <li>• Number of safe sites within PA.</li> <li>• Number of programs within PAs that consider the effects of livestock on plant diversity and regeneration.</li> <li>• Number of trees in safe sites.</li> <li>• <i>Q. brandegeei</i> included in the updated management plan for the Sierra La Laguna.</li> </ul>

OBJECTIVES	ACTIONS	INDICATORS OF SUCCESS
<p>3) Provide science-backed recommendations that ensure the health and fitness of remaining <i>Q. brandegeei</i> populations.</p>	<p>a. Work with PA managers in the Sierra La Laguna Biosphere Reserve to manage existing livestock.</p> <p>b. Promote invasive species removal that will benefit the regeneration of <i>Q. brandegeei</i>.</p>	<ul style="list-style-type: none"> <li>• Provide the information and tools to better understand the vegetation in each of the <i>Q. brandegeei</i> populations to inform future restoration efforts.</li> <li>• Monitor more than three of the <i>Q. brandegeei</i> populations that have been restored through the removal of invasive species.</li> <li>• Create guidelines to share with landowners on how to care for and manage native <i>Q. brandegeei</i> on their properties.</li> </ul>

**Responsible Parties and Collaborators:** CIBNOR, The Morton Arboretum, CONANP-REBIOSLA, “Proyecto Salvemos al Encino Arroyero,” residents of the communities, SEMARNAT-CONAFOR, Department of Ecology and Environmental Education of the municipalities of Los Cabos and La Paz, CODEMA A.C.



San Dionisio Canyon, within the Sierra La Laguna Biosphere Reserve, Baja California Sur. (The Morton Arboretum)

## ACTION #3

### GOAL:

Implement direct actions that result in recovered *Q. brandegeei* populations in its native range, as well as promote botanical living collections as an insurance policy against extinction.

### RATIONALE:

Because *Q. brandegeei* populations are declining and its distribution and habitat are extremely constrained, direct actions to recover populations are needed. This requires a variety of resources and techniques that contribute to the recovery of individuals or populations both *in situ* and *ex situ*. We propose working with botanic gardens and other locations to create a metacollection of *Q. brandegeei* that is genetically representative.

OBJECTIVES	ACTIONS	INDICATORS OF SUCCESS
<p>1) Establish reintroduction programs.</p>	<p>a. Reintroduction focused on sites that strengthen remaining populations and address connectivity issues.</p> <p>b. Execute a seedling adoption and care program “Salvemos al Encino Arroyero” in collaboration with locals and park rangers.</p> <p>c. Work with municipalities and private landowners to plant <i>Q. brandegeei</i> in urban areas in the Cabo region.</p>	<ul style="list-style-type: none"> <li>• Seeds collected per year and seedlings produced.</li> <li>• Number of programs and/or projects for the reintroduction of the species executed.</li> <li>• Number of seedlings planted in the region.</li> </ul>
<p>2) Promote the establishment of living collections in botanical gardens.</p>	<p>a. Create a propagation manual for the species.</p> <p>b. Leverage the GCCO network to establish and strengthen collaborations with nurseries, community gardens, botanic gardens, and arboreta.</p> <p>c. Share seed and seedlings with gardens for establishment in their living collections.</p> <p>d. Work with the GCCO to establish a methodology to manage and track the metacollection.</p>	<ul style="list-style-type: none"> <li>• Propagation manual created.</li> <li>• Number of seeds propagated for <i>ex situ</i> collections.</li> <li>• Number of collections established in botanical gardens.</li> <li>• Metacollection data management system in place with updated data.</li> <li>• CIBNOR registered as official species steward for <i>Q. brandegeei</i>.</li> </ul>

**Responsible Parties and Collaborators:** CIBNOR, The Morton Arboretum, CONANP, “Salvemos al Encino Arroyero,” residents of the communities, Mexican Association of Botanical Gardens (AMJB), and National Network of Ethnobiological Gardens, and ArbNet.



## ACTION #4

### GOAL:

Have informed and empowered stakeholders and community members in the Cape Region, who support *Q. brandegeei* through knowledge sharing, support of policy, participation in communal activities, and engagement in environmental education programs.

### RATIONALE:

This Action Plan seeks the exchange of knowledge, values, and experiences between key stakeholders for the conservation of *Q. brandegeei*. Scientific knowledge is shared through the dissemination of educational and outreach materials, allowing people to better understand the main biological and ecosystem functions of the species. We also plan to use multiple networks and avenues to activate key stakeholders and disseminate the information related to this plan.

OBJECTIVES	ACTIONS	INDICATORS OF SUCCESS
<p>1) Develop educational and outreach materials that raise awareness about the threats to <i>Q. brandegeei</i> and its current status.</p>	<p>a. Promote the participation of universities, foundations and civil organizations in environmental education activities. b. Create outreach materials to disseminate information (e.g., Encino arroyero video, festival).</p>	<ul style="list-style-type: none"> <li>• Number of communities and educational centers trained, and teaching materials produced.</li> <li>• Number of institutions involved in the environmental education process.</li> </ul>
<p>2) Inform and train environmental activists and PA managers in the Cape Region about the importance of conservation of the species.</p>	<p>a. Hold workshops to inform and exchange knowledge and experiences on the conservation of the species in the region. b. Promote local traditions and knowledge for the use and conservation of the species. c. Build capacity to propagate the species among the staff of the PA and other stakeholders</p>	<ul style="list-style-type: none"> <li>• Number of training sessions carried out for members of communities or social groups, park rangers, tourism service providers and decision makers.</li> <li>• Number of stakeholders with increased knowledge and understanding of the conservation status of <i>Q. brandegeei</i>.</li> </ul>
<p>3) Raise awareness and share information locally, regionally, and globally.</p>	<p>a. Leverage partners and networks to disseminate information in social media and in other relevant venues, such as scientific meetings, community workshops, talks, and presentations.</p>	<ul style="list-style-type: none"> <li>• Number of talks, articles, presentations, etc.</li> <li>• Number of people and different stakeholders reached.</li> </ul>

**Responsible Parties and Collaborators:** CIBNOR, The Morton Arboretum, CONANP-REBIOSLA, “Salvemos al Encino Arroyero,” residents of the communities, SEMARNAT-CONAFOR, Department of Ecology and Environmental Education of the municipalities of Los Cabos and La Paz, Kumutú-STEAM, Rancho Cacachilas, CODEMA A.C., Urbanería and Ecology Project International (EPI).



# NEXT STEPS



Team photo at the First Community Conservation Festival of *Quercus brandegeei* in the Santiago Delegation, Baja California Sur. (The Morton Arboretum)

This document represents a summary of the action plan that was initiated in September/October 2021 as a result of the workshop for the conservation of *Quercus brandegeei*. It is reviewed annually by the working group. This plan follows a 5-year timeline but is updated periodically through email communications and meetings, and annual workshops will be held to evaluate the overall plan, discuss changes, and update each other on achievements as well as gaps in our efforts. Additional information can be added at any time, provided it is reviewed and accepted by all who participated in the workshops and who will be carrying out the activities set out in the plan. For updates to this plan, visit [mortonarb.org/arroyo](http://mortonarb.org/arroyo).

Each action table has identified responsible stakeholders and collaborators. This will ultimately form a working group who will meet and communicate on a quarterly basis to ensure activities are executed over the given timeframe. Overall, further support through collaborations, resources, and funding will be critical to the implementation and success of these activities. For more information on how to participate or support these efforts, please contact the GCCO Coordinator and Species Action Plan Manager.

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# APPENDIX A

List of participants at the first community workshop “Conservación del Encino Arroyero (*Quercus brandegeei*)” in San Dionisio, Los Cabos, Baja California Sur and the symposium in La Paz, Baja California Sur, October 2021.

Workshop Participants		Symposium Participants	
Name	Organization	Name	Organization
Víctor M. Anguiano H.	CONAP/RBSL	Silvia Alvarez-Clare	The Morton Arboretum
Osiel A. Flores Rojas	CONAP/RBSL	Daniel Pérez Morales	CIBNOR/Proyecto Encino Arroyero
Alejandra Y. Barrios S.	CONAP/RBSL	Christie Klimas	DePaul University
Elizabeth Álvarez Rosas	Municipio de Santiago	Sean Hoban	The Morton Arboretum
Leticia Lizbeth García C.	Subdelegación Zacatal II	Marco A. Gonzales Viscarra	CONANP/RBSL
Daniel Cota Castillo	Municipio de Santiago	Aurora Breceda Solís	CIBNOR
Inés Núñez Cosío	Comunidad	Victor M. Anguiano Huerta	CONANP/RBSL
Jazmín Itzel Núñez N.	Comunidad	Fany Reyes Bolaños	Comunidad/CIBNOR
Linet Núñez	Comunidad	Roberto Mendía Santana	CONAFOR
Estefana González	Comunidad	José Luis León de la Luz	CIBNOR
Herlindo Castro C.	Comunidad	Consuelo Bonfil	UNAM
Karminia Carolina Castro G.	Comunidad	Juan A. Hernandez S.	CODEMA AC
Rosario G. Rosas López	Comunidad	Carlos U. McGregor B.	CODEMA AC
Aurora Breceda Solís	CIBNOR	Elizabeth Álvarez Rosas	Municipio de Santiago
Francisco Gómez M.	CODEMA AC	María Rosas Espinoza	Comunidad
Gloria Carillo	Comunidad	Karminia Carolina Castro	Comunidad
Rogelio Rosas López	Comunidad	Antonio Gonzalez R.	UNAM
Antonio González R.	UNAM	Mariana Fuentes Zarco	Proyecto Encino Arroyero
Christie Klimas	DePaul University		
Sean Hoban	The Morton Arboretum		
Abelino Cota Castro	Comunidad/CIBNOR		
Fanny Reyes Bolaños	Comunidad/CIBNOR		
Silvia Alvarez-Clare	The Morton Arboretum		
Aranza Mendoza Sánchez	UABCS		
Diana Larua Martínez Lugo	UABCS		
Obed Rafael Caballero Martínez	UABCS		
Manuel Osuna Flores	UABCS		
Karina M. Bailon Grijalva	UABCS		
Matthew Taylor	The Morton Arboretum		
Daniel Pérez Morales	CIBNOR/Proyecto Encino Arroyero		



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*Quercus brandegeei* in its native  
habitat (The Morton Arboretum)

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