



# Conservation Gap Analysis of Native U.S. Oaks

## Species profile: *Quercus tomentella*

Emily Beckman, David Pivorunas, 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*

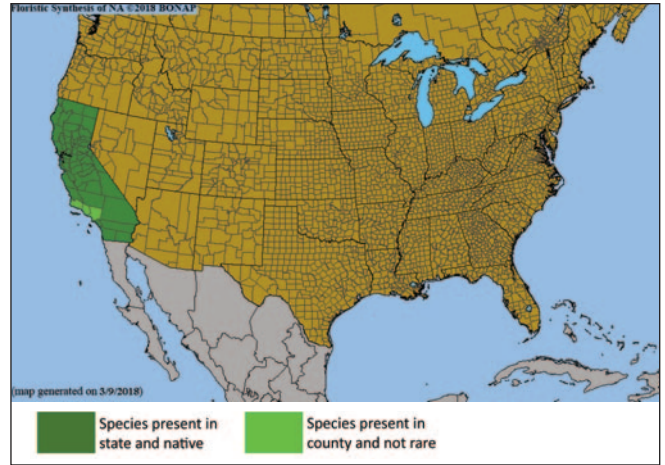


# Quercus tomentella Engelm.

**Synonyms:** *Quercus chrysolepis* subsp. *tomentella* (Engelm.) A.E.Murray, *Q. chrysolepis* var. *tomentella* (Engelm.) A.E.Murray, *Q. tomentella* var. *conjugens* Trel. **Common Names:** Island oak

**Species profile co-author:** David Pivorunas, National Forest System, USDA Forest Service  
**Contributors:** Mary Ashley, Biological Sciences, The University of Illinois in Chicago; Jonathan Dunn, AECOM; Kaius Helenurm, Biology, University of South Dakota; Jan Larson, U.S. Navy Region Southwest, retired

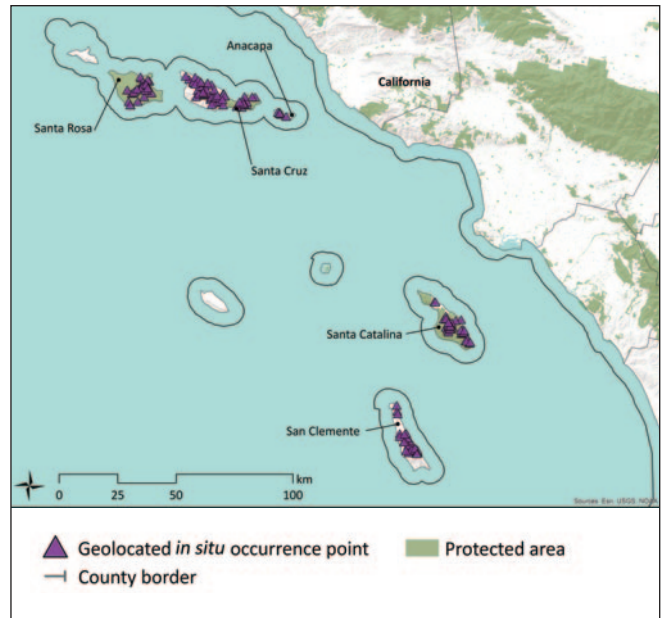
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**Figure 1.** County-level distribution map for the U.S. distribution of *Quercus tomentella*. Source: Biota of North America Program (BONAP).<sup>5</sup>

## DISTRIBUTION AND ECOLOGY

*Quercus tomentella*, also known as Island oak, is found only on the Channel Islands (Santa Rosa, Santa Cruz, Anacapa, Santa Catalina, and San Clemente) off the coast of California, U.S., and on Guadalupe Island, Mexico. The species belongs to a small, mysterious group of oaks that only exists in the western U.S. and northern Baja California, Mexico: the intermediate or golden oaks, section *Protobalanus*. The island habitats of *Q. tomentella* give protection from frost and drought, and sufficient moisture is provided through a combination of precipitation and fog drip. Strong winds keep the tree from thriving too close to the coast. Island oak prefers deep, moist soils within sheltered locations from 100 to 650 meters above sea level, but can survive in almost any soil type. In the best conditions, a height of seven to 12 meters can be reached, but many individuals facing the harshest winds are shrunken and bent, pruned by salt spray. Reproduction through acorns is difficult because of winds and rocky soil, so many inland groves are held constant by sprouting from adult trees.<sup>1</sup> On San Clemente Island, the species grows in pure stands, usually within canyons or on the high, coastal, north-eastern slopes.<sup>2</sup> On the northern islands it forms a woodland community with Canyon oak (*Q. chrysolepis*) and Coast live oak (*Q. agrifolia*), in contrast to the woodlands on Santa Catalina Island where Island scrub oak (*Q. pacifica*) dominates, while *Q. tomentella* and *Q. chrysolepis* are less frequent.<sup>3,4</sup>



**Figure 2.** Documented *in situ* occurrence points for the U.S. distribution of *Quercus tomentella*. Protected areas layer from U.S. Geological Survey Gap Analysis Program (GAP) 2016 Protected Areas Database of the U.S. (PAD-US).<sup>6</sup>

## VULNERABILITY OF WILD POPULATIONS

**Table 1.** Scoring matrix identifying the most severe demographic issues affecting *Quercus tomentella*. 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	10
Range/endemism	Extremely small range or 1 location	E00 < 100 km <sup>2</sup> or A00 < 10 km <sup>2</sup> or 2-4 locations	E00 < 5,000 km <sup>2</sup> or A00 < 500 km <sup>2</sup> or 5-9 locations	E00 < 20,000 km <sup>2</sup> or A00 < 2,000 km <sup>2</sup> or 10+ locations	E00 > 20,000 km <sup>2</sup> or A00 > 2,000 km <sup>2</sup>	Unknown	10
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	20
Regeneration/recruitment	No regeneration or recruitment	Decline of >50% predicted in next generation	Insufficient to maintain current population size	Sufficient to maintain current population size	Sufficient to increase population size	Unknown	5
Genetic variation/integrity	Extremely low	Low	Medium	High	Very high	Unknown	5
Average vulnerability score							8.3
Rank relative to all U.S. oak species of concern (out of 19)							11

## THREATS TO WILD POPULATIONS

### High Impact Threats

**Human modification of natural systems – disturbance regime modification, pollution, and/or eradication:** Non-native livestock stripped much of the vegetation on Santa Catalina Island before their removal in the late 20th century. Studies of restoration potential for *Q. tomentella* on the Island point to weed saturated soils as a main challenge.<sup>3</sup> It is clear that overgrazing damaged the majority of native flora, resulting in increased competition from invasive plants (M. Ashley pers. comm., 2015).

### Moderate Impact Threats

**Extremely small and/or restricted population:** Only four individuals remain on the small island of Anacapa, though populations are much larger on the other islands, excluding Guadalupe.<sup>1</sup>

### Low Impact Threats

**Human use of landscape – agriculture, silviculture, ranching, and/or grazing:** Intense past overgrazing from introduced herbivores degraded much of *Q. tomentella*'s habitat, causing population declines.<sup>7</sup> Almost all of the introduced grazing animals have now been removed from the species' range and the ecosystem is recovering slowly. Guadalupe Island was the last to eradicate all

introduced herbivores, which took place between 2003 and 2006. By 2011 the Island's habitats were already showing improvement, but *Q. tomentella* has not yet shown signs of regeneration.<sup>8</sup> Some mature specimens on Guadalupe Island have died due to soil erosion and the population is less than 50 individuals.<sup>9</sup>

**Human Use of Landscape - e.g. residential, commercial, mining, roads:** Past mining and harvesting of oaks for construction, heating, etc. could have contributed to dieback of native oaks on Santa Catalina Island; current roads could also be having a negative effect. There is little evidence for ongoing adverse human impacts on Santa Rosa and Santa Cruz Islands, as both have small settlements and infrequent road use.<sup>10</sup>

**Human Use of Landscape - e.g. tourism and recreation:** Recreation is another possible threat contributing to dieback on Santa Catalina Island, which is the only Channel Island with an incorporated city and about one million visitors annually.<sup>11</sup> The northern islands receive much less visitation because the Channel Islands National Park is explicitly managed as a low-visitation park.<sup>12</sup>

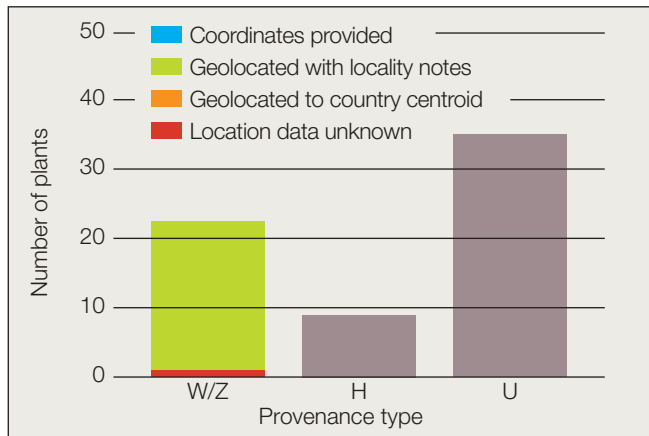
**Climate change – habitat shifting, drought, temperature extremes, and/or flooding:** Predicted lengthening of dry seasons may present a challenge for natural regeneration of *Q. tomentella*. Though, climate change may not have a significant impact on the Channel Islands since the climate is already extremely dry and fog drip will not likely be significantly altered.<sup>13</sup>

## CONSERVATION ACTIVITIES

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

### Results of 2017 *ex situ* survey

Number of <i>ex situ</i> collections reporting this species:	18
Number of plants in <i>ex situ</i> collections:	67
Average number of plants per institution:	4
Percent of <i>ex situ</i> plants of wild origin:	34%
Percent of wild origin plants with known locality:	96%



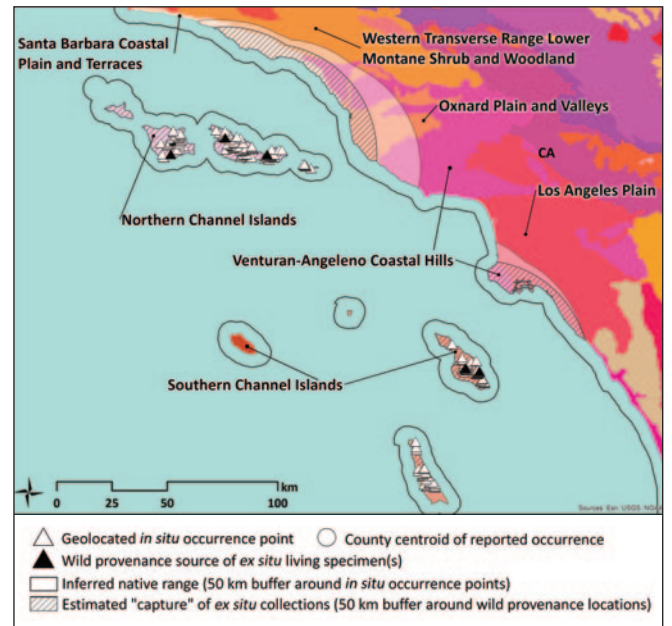
**Figure 3.** Number and origin of *Quercus tomentella* plants in *ex situ* collections. Provenance types: W = wild; Z = indirect wild; H = horticultural; U = unknown.



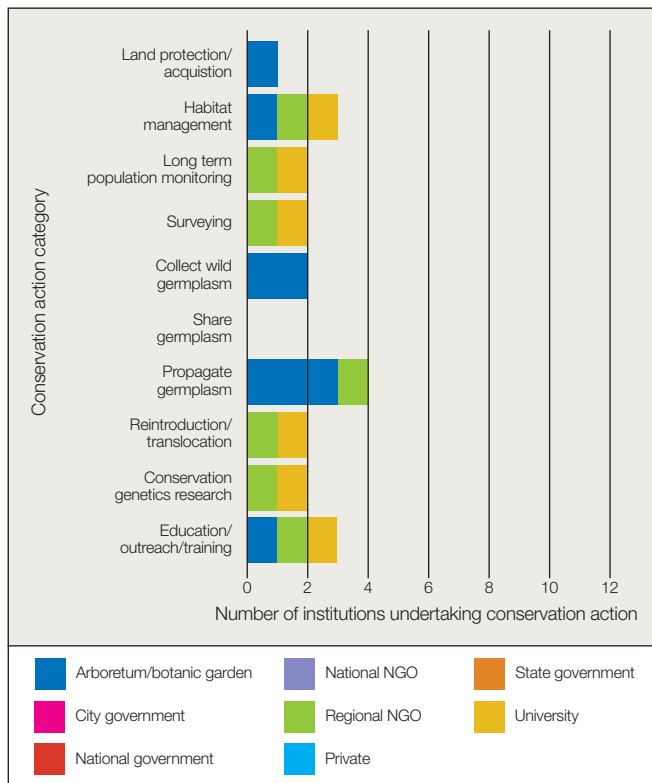
A spatial analysis was conducted to estimate the geographic and ecological coverage of *ex situ* collections (Figure 4). Only the native U.S. distribution of the species was considered in this analysis, due to availability of ecoregion maps. Fifty-kilometer buffers were placed around each *in situ* occurrence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

### Estimated *ex situ* representation

Geographic coverage:	57%
Ecological coverage:	100%



**Figure 4.** *Quercus tomentella* *in situ* occurrence points and *ex situ* collection source localities within the United States. U.S. EPA Level IV Ecoregions are colored and labeled.<sup>16</sup> County centroid is shown if no precise locality data exist for that county of occurrence. Email [treeconservation@mortonarb.org](mailto:treeconservation@mortonarb.org) for information regarding specific coordinates.



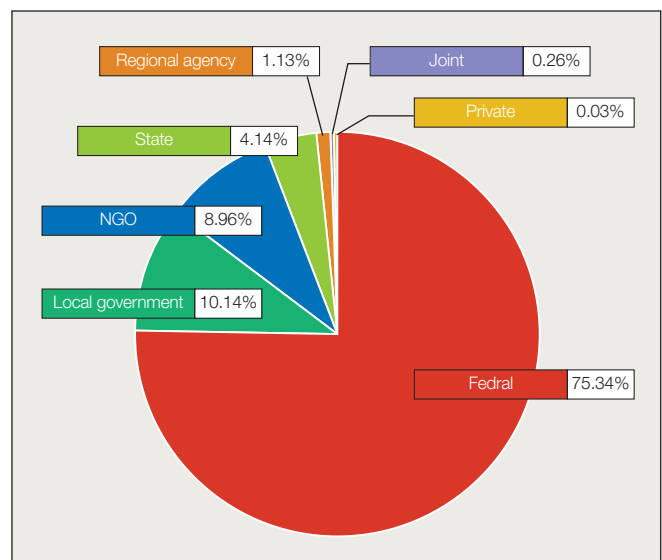
**Figure 5.** Number of institutions reporting conservation activities for *Quercus tomentella* grouped by organization type. Seven of 252 institutions reported activities focused on *Q. tomentella* (see Appendix D for a list of all responding institutions).

**Land protection:** Within the inferred native range of *Q. tomentella* in the U.S., 44% of the land is covered by protected areas (Figure 6). However, because this species' distribution is small and well-documented, we know that close to 100% of the species' habitat is within protected areas.

The entirety of Anacapa Island, Santa Rosa Island, and Santa Cruz Island are part of Channel Islands National Park, while the oak habitat on Santa Catalina Island is managed by the Catalina Island Conservancy. San Clemente Island is federally owned and managed by the Navy, which has a long established Natural Resource program and an Integrated Natural Resource Management Plan.<sup>17</sup> The non-profit organization Conservation de Islas was initiated in 2004 to restore Guadalupe Island and continues to manage the land.<sup>18</sup> The Island was officially declared a Biosphere Reserve in 2005 by the Mexican government.<sup>19</sup>

**Sustainable management of land:** In 1997 the Catalina Island Conservancy began a restoration program after 50 years of ranching and farming, which included the removal of feral goats and pigs island-wide as well as the conversion of 80 acres of previous hayfields to native plant communities. Invasive plants are still an issue and the Conservancy has identified 76 invasive plant species as potential weeds in need of control and/or eradication. In response to this threat, the entire island has been mapped and the Catalina Habitat Improvement and Restoration Program (CHIRP) is actively managing 43 invasive plants to stop further invasion.<sup>20</sup>

Channel Island National Park began eradicating introduced livestock on their land in the 1990s and no individuals remain today. The Navy began a goat removal program on San Clemente Island in the 1970s as the Natural Resource Program was developed; removal continued until the all goats, as well as non-native pigs and deer, were eradicated in the early 1990s. The Navy also contracts with specialists to remove targeted weeds and invasive plant species, which may be spreading on the Island; they also developed an Integrated Natural Resource Management Plan and Fire Management Plan for the Island.<sup>21,22</sup> The Group for Ecology and Island Conservation (GECI) has been working to restore Mexican island ecosystems since 1995, and began non-native animal removal on Guadalupe in 2002. By 2007 all goats had been removed, but invasive plants from the Mediterranean Basin and Europe dominate open areas and there is extensive soil erosion.<sup>9</sup>



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



**Population monitoring and/or occurrence surveys:** A flora of San Clemente Island was first published in 1963 by Peter Raven.<sup>23</sup> Once the Island's Natural Resource program began in the 1970s, more surveys and inventories were conducted.<sup>24,25</sup> The Navy contracted Santa Barbara Botanic Garden to conduct comprehensive surveys of the Island's rare species in 1996 and 1997, which included an inventory of *Q. tomentella*.<sup>2</sup> Other rare species surveys included those conducted by Steve Junak in 2003 and 2004, as well as Kellogg and Kellogg's repeated surveys of over 100 vegetative transects around the Island.<sup>26</sup> These transects were first set up in the 1990s and inventoried on a regular basis to measure recovery of the island species after goat removal. Oak populations on San Clemente Island are healthy and have responded well to the removal of the goats, with some natural regeneration in at least one location observed in 2003 (D. Pivorunas pers. comm., 2018).

The Catalina Island Conservancy monitors oak dieback through an annual survey in July. In the most recent survey, they found that "large stands of dead oaks are forming around Catalina, mostly on the channel side of the Island. This could be due to any of a number of interacting factors, including old age (and lack of regeneration due to feral animals), oak root rot fungus, air pollution, and water cycles... [but] progress of the dieback is slow, suggesting that it is not a pathogen that is causing the deaths."<sup>27</sup>

**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:** The Tree of Life Nursery has been producing native California plants for more than two decades and is one of the largest suppliers of native plants in the state. Their grounds include 30 acres of growing area in addition to laboratory facilities for the propagation and testing of mycorrhizal plants and inoculum. They grow a wide variety of native oak species, including *Q. tomentella*.<sup>28</sup> The Tree Plantation also reports propagating and selling *Q. tomentella*.<sup>29</sup>

**Reintroduction, reinforcement, and/or translocation:** In 2000, the Navy began revegetation efforts on San Clemente Island. This initiative included propagating native shrubs and trees from wild-collected San Clemente Island sources, then outplanting in 2001. Several hundred oaks seedlings were planted in multiple locations in the first two years, with about 80% survival one year after planting and 50% of the plants remaining after two years. Individuals seem to survive through fog drip moisture as adults, if some water is provided the first several years. The most favorable sites now host mature trees, which produced a good crop of acorns in 2013. Storage of seeds was successful for at least two to three years with refrigeration at ~32°F and a dusting of cinnamon powder (J. Dunn pers. comm., 2003, 2018).



Steve Matson

**Research:** Regeneration trials were conducted during the Catalina Island Conservancy restoration program. This study found that recruitment is feasible without providing additional water to the acorn or sapling.<sup>3</sup> The population genetics of Island oak on Santa Catalina Island has been characterized by sampling trees from many of the *Q. tomentella* stands and analyzing these individuals using microsatellites. Allelic and gene diversity were found to be “high and similar to microsatellite studies of mainland species of oaks,” but also exhibited a striking level of between-stand differentiation. High clonality was found on Santa Catalina and Santa Rosa Islands, but overall genetic diversity was high at all sites, including the tiny population on Guadalupe Island.<sup>14,30</sup> The Navy also conducts genetics studies on *Q. tomentella* through a contract with Dr. Kaius Helenurm, which included collecting and analyzing genetics tissue from ten different island locations (K. Helenurm pers. comm., 2002, 2018).

In 2006, University of California, Davis created a potential habitat model for Island oak, to estimate where the species could thrive on the Channel Islands; these data can direct habitat restoration and species reintroduction initiatives. Their model revealed that the species currently occupies less than 1% of modelled core habitat.<sup>2</sup>

*Quercus tomentella* restoration is also informed through the conservation management of rare animal species reliant on Island oak habitat.<sup>31,32</sup>

**Education, outreach, and/or training:** The East Palo Alto Tree Initiative, a “multi-year collaboration to enhance the urban forest in East Palo Alto and plant more than 1,200 trees,” included *Q. tomentella* in their urban plantings, in which hundreds of volunteers participated.<sup>33</sup> The Chino Basin Water Conservation District provides a description of *Q. tomentella*’s environmental needs within a landscape planting, including very specific water recommendations.<sup>34</sup>

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



## PRIORITY CONSERVATION ACTIONS

Although introduced grazers, once a primary threat to Island oak, have been removed from the majority of the species' distribution, natural recovery will be slow. Acorns are produced sporadically in most years and the conditions for good germination and survival will not necessarily coincide. Where populations are quite small, additional reintroduction and reinforcement efforts are vital, though all islands within the species' native range would benefit from continued reinforcement. These outplanting initiatives should use only wild collected genetic material that is sourced and produced locally on the island of reinforcement and/or reintroduction, to avoid introducing pests or diseases.

Restoration is especially important on Guadalupe Island, where genetic variability is relatively high but population numbers are low and some older trees have recently been lost to erosion. It is important that the existing trees are monitored, natural regeneration is encouraged, and reinforcement of populations is conducted. Because the population on Anacapa Island is even smaller (four individuals), it is vital to collect genetic material to avoid losing the population entirely. This material should be propagated and used for reinforcement to ensure survival of the species at this location.

Encouragement of natural regeneration on San Clemente Island should also continue, as well as plantings near existing groves and establishment of new groves in favorable habitat. The continuation of outplanting is also important because more knowledge is needed regarding the natural regeneration processes of this species. The activities of the past 15 years have provided a strong conservation base and should be continued. Natural regeneration of *Q. tomentella* is also a problem at sites within the Channel Island National Park, which includes Santa Cruz and Santa Rosa Islands.<sup>4</sup> These areas, in addition to Santa Catalina Island, need continued monitoring, research, and restoration of oak habitat, including the control of invasive plant species.

### Conservation recommendations for *Quercus tomentella*

#### Highest Priority

- Population monitoring and/or occurrence surveys
- Propagation and/or breeding programs
- Reintroduction, reinforcement, and/or translocation
- Wild collecting and/or *ex situ* curation

#### Recommended

- Research (reproductive biology/regeneration; restoration protocols/guidelines)
- Sustainable management of land



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