



Conservation Gap Analysis of Native U.S. Oaks

Species profile: *Quercus boyntonii*

Emily Beckman, Emma Spence, 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 toumeyii

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 boyntonii Beadle

Synonyms: *Quercus stellata* var. *boyntonii* (Beadle) Sarg. **Common Names:** Boynton oak

Species profile co-authors: Sean Hoban, The Morton Arboretum; Emma Spence, Center for Large Landscape Conservation
Contributors: Adam Black, Peckerwood Garden

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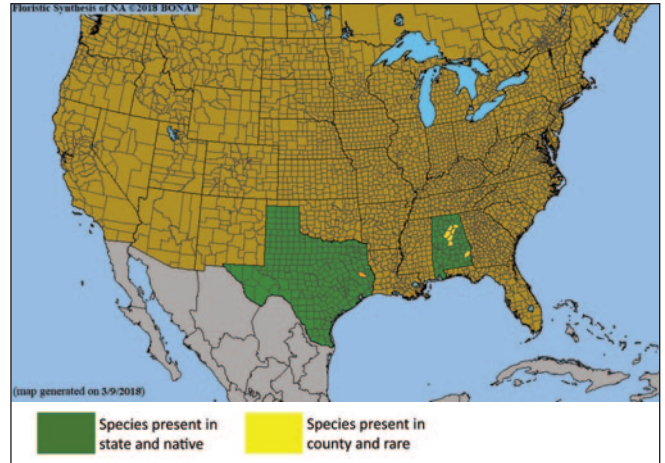


Figure 1. County-level distribution map for *Quercus boyntonii*. Source: Biota of North America Program (BONAP).³

DISTRIBUTION AND ECOLOGY

Quercus boyntonii, or Boynton oak, has a restricted distribution and is believed to be endemic to Alabama, U.S. The species was historically documented in eastern Texas, but recent efforts to locate this population have failed.¹ Boynton oak is best known from a few main populations, including Oak Mountain State Park, Moss Rock Preserve, and Hind’s Rock. Localized occurrences of sandstone outcrops within pine-oak-hickory forest frequently correlate with the presence of *Q. boyntonii* (E. Spence pers. comm., 2018).² In Texas, it was found in the shrub layer of Loblolly Pine-oak (*Pinus taeda*) forests on deep sandy soils in creek bottoms, and possibly in shallower soils of upland prairies. Boynton oak is a small tree reaching two to six meters tall.¹

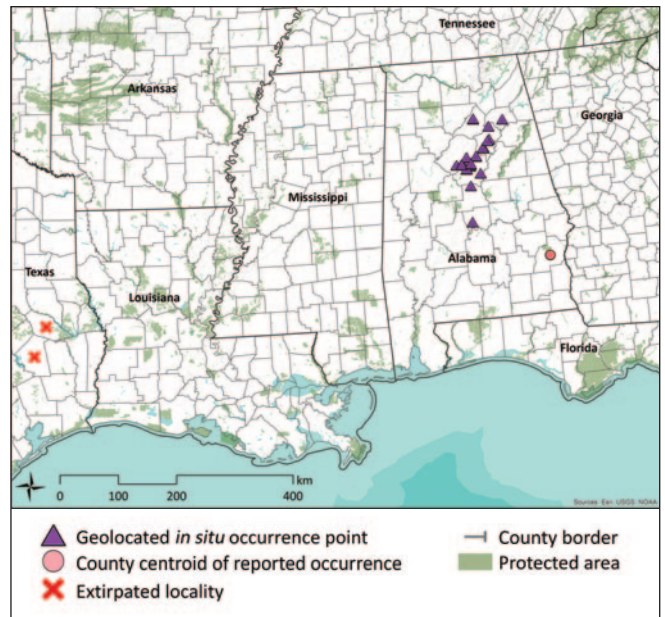


Figure 2. Documented *in situ* occurrence points for *Quercus boyntonii*. Protected areas layer from U.S. Geological Survey Gap Analysis Program (GAP) 2016 Protected Areas Database of the U.S. (PAD-US).⁴

VULNERABILITY OF WILD POPULATIONS

Table 1. Scoring matrix identifying the most severe demographic issues affecting *Quercus boyntonii*. 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 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	20
Population decline	Extreme	>= 80% decline	>= 50% decline	>= 30% decline	None	Unknown	10
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	20
Average vulnerability score							13.3
Rank relative to all U.S. oak species of concern (out of 19)							4

THREATS TO WILD POPULATIONS

High Impact Threats

Genetic material loss — inbreeding and/or introgression: Due to this species' rarity and occurrence with other oak species, hybridization may be a genetic threat. Morphology at several sites indicates possible introgression. Some populations are extremely small and therefore will likely face inbreeding in the near future. Genetic diversity is moderately low for an oak, based on genetic markers (unpublished). The overall population size of *Q. boyntonii* is likely too small to respond well to natural selection, making genetic adaptation unlikely in the future (S. Hoban pers. comm., 2018).

Moderate Impact Threats

Human modification of natural systems — disturbance regime modification, pollution, and/or eradication: *Quercus boyntonii* is experiencing woody encroachment due to fire suppression in its habitat.⁵

Human modification of natural systems — invasive species competition: Invasive plants such as Japanese honeysuckle provide significant competition, initially invading due to fire suppression.⁶

Climate change — habitat shifting, drought, temperature extremes, and/or flooding: Based on the Hadley B1 Scenario of climate change for 2050, there is only a 10% overlap of

future suitable range with present suitable range for *Q. boyntonii*. The percent change in area of suitable range is -52%.⁷ A recent analysis of U.S. tree vulnerability to climate change used species-specific intrinsic traits to assess trees species' risk of negative effects from climate change; Boynton oak was found to have moderate to high threat exposure and high sensitivity, but moderate adaptive capacity.⁸ Severe fire danger exists in some of the Boynton oak's most pristine and suitable habitat, due to a recent drought that killed many pines in the area (S. Hoban pers. comm., 2018).

Extremely small and/or restricted population: *Quercus boyntonii* has a restricted range due to very specific habitat type needs (E. Spence pers. comm., 2018).

Low Impact Threats

Human use of species — wild harvesting: Boynton oak is sometimes cut for use as firewood.²

Human use of landscape — residential/commercial development, mining, and/or roads: Trash disposal in natural areas and human development of land have degraded *Q. boyntonii* habitat.²

Human use of landscape — tourism and/or recreation: ATV use has been an issue in areas near Boynton oak populations, but direct effects are unknown.²

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:	17
Number of plants in <i>ex situ</i> collections:	320
Average number of plants per institution:	19
Percent of <i>ex situ</i> plants of wild origin:	98%
Percent of wild origin plants with known locality:	99%

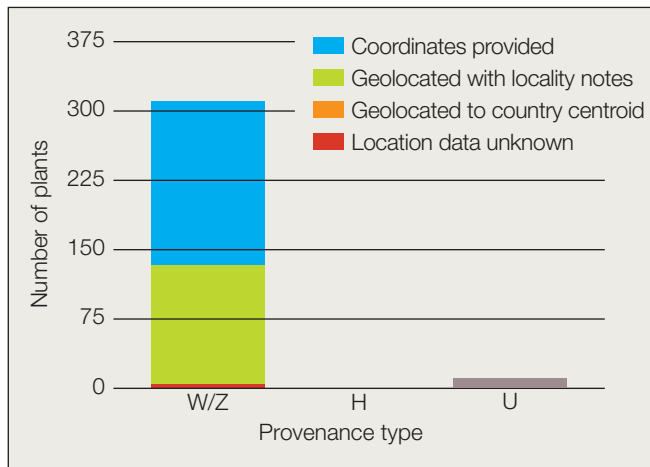


Figure 3. Number and origin of *Quercus boyntonii* plants in *ex situ* collections. Provenance types: W = wild; Z = indirect wild; H = horticultural; U = unknown.

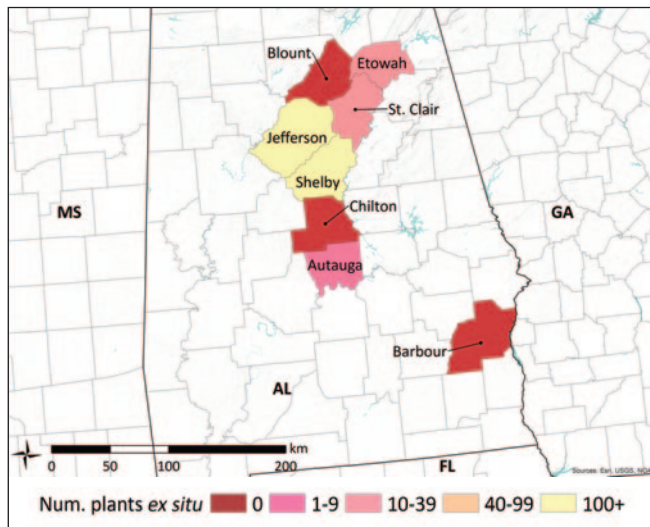


Figure 4. *Quercus boyntonii* counties of *in situ* occurrence, reflecting the number of plants from each county in *ex situ* collections.

A spatial analysis was conducted to estimate the geographic and ecological coverage of *ex situ* collections (Figure 5). 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:	70%
Ecological coverage:	76%

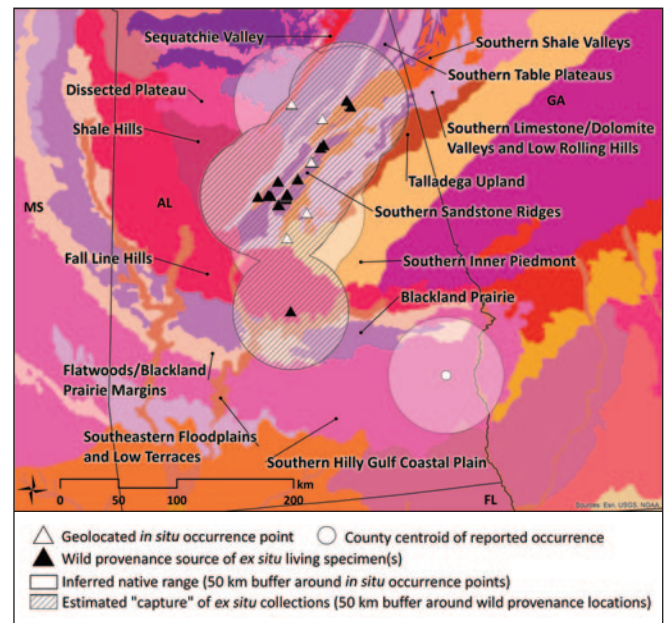


Figure 5. *Quercus boyntonii* *in situ* occurrence points and *ex situ* collection source localities. U.S. EPA Level IV Ecoregions are colored and labelled.⁹ County centroid is shown if no precise locality data exist for that county of occurrence. Email treeconservation@mortonarb.org for more information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



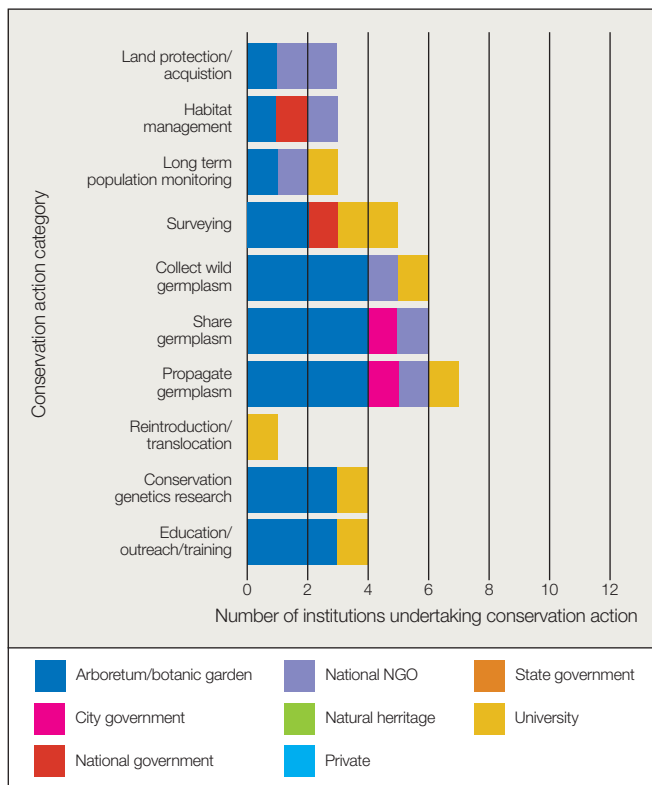


Figure 6. Number of institutions reporting conservation activities for *Quercus boyntonii* grouped by organization type. Twelve of 252 institutions reported activities focused on *Q. boyntonii* (see Appendix D for a list of all responding institutions).

Land protection: Within the inferred native range of *Q. boyntonii*, 6% of the land is covered by protected areas (Figure 7). Some key populations are protected, but the majority are found on private land; though land management in these protected areas may not be ideal for Boynton oak.

In 2014 an important subpopulation of *Q. boyntonii*, located in the city of Gadsden, Alabama, was purchased by the non-profit Forever Wild.⁵ This is the site where the type specimen was collected in 1901. Oak Mountain State Park also provides protection for *Q. boyntonii*, along with Moss Rock Preserve.

Sustainable management of land: While working in Alabama, the North American Land Trust (NALT) Conservation Biologist Lee Echols discovered a population of Boynton oak on privately owned land. NALT is now working with the landowners to develop a management plan to control severe Japanese honeysuckle infestations.⁶

Population monitoring and/or occurrence surveys: The reported population of *Q. boyntonii* in Texas, which has never been relocated and assumed extirpated, will be visited to confirm presence or absence (A. Black pers. comm., 2017).

Wild collecting and/or ex situ curation: In 2015, The Morton Arboretum and Donald E. Davis Arboretum of Auburn University, with support from the APGA-USFS Tree Gene Conservation Partnership, collected *Q. oglethorpensis* across its natural range in Mississippi, Alabama, and South Carolina. Because *Q. boyntonii* is located in relative proximity to some *Q. oglethorpensis* populations, they collected Boynton oak as well. Collections were made at three different sites, with one site including six different populations.¹⁰

Propagation and/or breeding programs: Seeds of *Q. boyntonii* collected in 2015 during the APGA-USFS Tree Gene Conservation Partnership collecting project for *Q. oglethorpensis* were propagated at multiple botanic gardens and arboreta; good germination has been reported from The Morton Arboretum and Davis Arboretum.¹¹ Birmingham Botanical Gardens has also been propagating *Q. boyntonii* for five years and has distributed these seedlings on a limited basis. They report that, “ease of propagation, relatively small stature, and inherent tolerance of open, dry and rocky sites make this tree species a good candidate for wider landscape use and possible reintroduction.”¹²

Reintroduction, reinforcement, and/or translocation: One institution reported this activity in the conservation action questionnaire, but no other details are currently known.

Research: During an Alabama Plant Conservation Alliance meeting in 2014, Patrick Thompson described Auburn University’s current propagation findings and proposed further research: “this species seems to be holding its own, though a narrow range and specific site requirements means it is one worth developing propagation protocols and good baseline data. We have been successful growing it from root cuttings and acorns, though acorn production is often low.”¹⁵

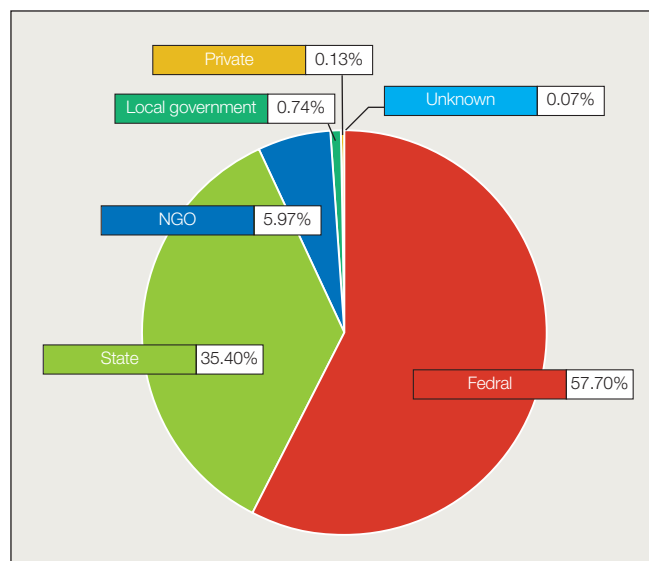


Figure 7. Management type of protected areas within the inferred native range of *Quercus boyntonii*. Protected areas data from the U.S. Geological Survey Gap Analysis Program (GAP) 2016 Protected Areas Database of the U.S. (PAD-US).³



Sean Hoban

The Morton Arboretum is performing a conservation genetic analysis of most known populations. Their initial results suggest that the species has moderately low heterozygosity in comparison to most oaks. The species does not appear to be suffering inbreeding yet, but the very small size of most populations (less than 25 individuals) suggests that it will be facing this issue in the near future. Some individuals show morphology that may indicate hybridization and threat of introgression, but this has not yet been confirmed with genetic data. The overall small census size of the species (a few hundred) suggests that even if some populations do avoid inbreeding, the populations are not large enough to respond to natural selection and adapt to a changing environment (S. Hoban & E. Spence pers. comm., 2018).

Education, outreach, and/or training: In his diligent work to conserve *Q. boyntonii*, Thompson is also working to “increase awareness of the species to avoid unnecessary losses.”¹¹ To this end, he and Sean Hoban are continuing to actively seek funding to support *Q. boyntonii* outreach (S. Hoban pers. comm., 2018).

Species protection policies: In June and July 2007, WildEarth Guardians submitted two separate petitions requesting listing of 674 species under the Endangered Species Act (ESA), including *Q. boyntonii*. This species had previously been an ESA candidate in 1990 and 1993, but was removed from the candidate list in 1996.¹³ In 2009 another petition for listing *Q. boyntonii* was submitted to the U.S. Fish and Wildlife Service, along with 474 other species in the southwestern U.S. *Quercus boyntonii* was determined to have an inadequate amount of threat information provided in the petition, and was subsequently rejected.¹⁴

In addition to listing species as endangered or threatened, Texas maintains a list of more than 1,300 Species of Greatest Conservation Need (SGCN). These species are “declining or rare and in need of attention to recover or to prevent the need to list under state or federal regulation...[and are] the focus of Texas Parks and Wildlife Department’s Texas Conservation Action Plan,” but are not provided the same protections as endangered or threatened species. *Quercus boyntonii* is listed as a SGCN.¹⁵

PRIORITY CONSERVATION ACTIONS

Severe fire danger exists in some of the Boynton oak’s most pristine and suitable habitat, due to a recent drought that killed many pines in the area. This buildup of fuel could cause an unusually severe fire, likely destroying all oaks in the area. Thus, a reduction in fuel load by removal of dead wood is urgent. Eventually a return of regular, low-level fire should help alleviate this threat. Due to the suburban location of some sites, and significant edge effects, numerous invasive plants have also established and seem to be outcompeting Boynton oak for light. Removal of invasive species, and continued routine monitoring and management of invasive species is needed.

There is also a lack of knowledge regarding population size, species distribution, and hybridization and regeneration rates. While all Boynton oak sites have small populations, it is difficult to determine actual population size and regeneration due to a propensity of this species to expand clonally. DNA fingerprinting could be used to determine whether observed stems are clones or unique individuals, allowing for a more accurate count of population size and updating of its threat status. To determine species distribution and perhaps identify additional population locations, surveys of a few large, unexplored private and public tracts of land are needed. In addition, a study of hybridization and introgression is necessary to assess whether hybridization could threaten genetic integrity of this species. Protection of significant populations on private land could also be considered when possible.

Lastly, both *ex situ* conservation to safeguard against loss in the wild and increasing public awareness will aid in averting species decline. One avenue includes establishing plantings and interpretive material at zoos and botanic gardens. Interpretive information can educate the public about Boynton oak, provide advice (e.g., information about accidental damage from firewood collection, off-road vehicle use, etc.), and help encourage public commitment towards volunteer efforts (e.g., invasive plants or fuel load removal). Furthermore, seed from *ex situ* material can be used for planting and restoration *in situ* if needed, such as augmentation or relocation of very small populations or those experiencing severe threat from hybridization.

Conservation recommendations for *Quercus boyntonii*

Highest Priority

- Sustainable management of land
- Population monitoring and/or occurrence surveys
- Research (demographic studies/ecological niche modeling; land management/disturbance regime needs; population genetics)
- Education, outreach, and/or training

Recommended

- Land protection
- Wild collecting and/or *ex situ* curation
- Reintroduction, reinforcement, and/or translocation

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