Conservation Gap Analysis of Native U.S. Oaks

Species profile: Quercus austrina
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SPECIES OF CONSERVATION CONCERN

CALIFORNIA
Channel Island endemics:
Quercus pacifica, Quercus tomentella

Southern region:
Quercus cedrosensis, Quercus dumosa, Quercus engelmannii

Northern region and/or broad distribution:
Quercus lobata, Quercus parvula, Quercus sadleriana

SOUTHWESTERN U.S.
Texas limited-range endemics
Quercus carmenensis, Quercus graciliformis, Quercus hinckleyi, Quercus robusta, Quercus tardifolia

Concentrated in Arizona:
Quercusajoensis, Quercus palmeri, Quercustoumeyi

Broad distribution:
Quercushavardii, Quercuslaceyi

SOUTHEASTERN U.S.
State endemics:
Quercusacerifolia, Quercusboyntonii

Concentrated in Florida:
Quercuschapmanii, Quercusinopina, Quercuspumila

Broad distribution:
Quercusarkansana, Quercusaustrina, Quercusgeorgiana, Quercusoglethorpesis, Quercussimilis
DISTRIBUTION AND ECOLOGY

Quercus austrina, or Bluff oak, is endemic to the Southeastern Coastal Plain of the U.S., distributed from North Carolina to Georgia, and possibly west to Arkansas; it stretches from maritime forests near the coastline, inland to sandy coastal plains. The species was described in 1918 as “although not generally distributed is not rare.” Since then, habitat clearing and disturbance by human activities may have led to a decline in the species’ prevalence. It is also possible that further taxonomic research and skill in identification have created the illusion of decline. In 1997 Bluff oak was described as “apparently abundant only in local areas,” and “nowhere common” in 2015. In 2005 NatureServe recorded only 38 occurrences that were not historic or extirpated. This limited abundance is largely a response to Q. austrina’s habitat specificity and rarity. Flat tops of wooded bluffs and nearby stream ravines currently harbor most remaining Q. austrina, in addition to hardwood hammocks; further occurrences sprinkle the woods of the sandy coastal plains where regeneration can be difficult. There is potential to find Q. austrina in any deep, mesic or sub-mesic sandy soil with high organic content (R. Lance pers. comm., 2015). Bluff oak is a relatively small or medium-sized tree, typically reaching 20 to 26 meters in height, and thrives at 0 to 200 meters above sea level.

Significant work remains in understanding the distribution of Bluff oak. Species records within Arkansas, Mississippi, and Alabama are highly suspicious and need further investigation. It is likely that many of the herbarium specimens have been confused with Q. sinuata. Recent expert surveys in Alabama have not positively identified any Q. austrina, and if the species is present within the western half of its currently-recorded range, it is certainly not common. Herbarium and field work could substantially change the range and conservation status of this species, and is a vital element of analysis moving forward (R. Lance & D. Pivorunas pers. comm., 2018).
VULNERABILITY OF WILD POPULATIONS

Table 1. Scoring matrix identifying the most severe demographic issues affecting *Quercus austrina*. 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).

<table>
<thead>
<tr>
<th>Demographic indicators</th>
<th>Level of vulnerability</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Emergency</td>
<td>High</td>
</tr>
<tr>
<td>Population size</td>
<td>&lt; 50</td>
<td>&lt; 250</td>
</tr>
<tr>
<td>Range/endemism</td>
<td>Extremely small range or 1 location</td>
<td>EOO &lt; 100 km² or AOO &lt; 10 km² or 2-4 locations</td>
</tr>
<tr>
<td>Population decline</td>
<td>Extreme</td>
<td>&gt;= 80% decline</td>
</tr>
<tr>
<td>Fragmentation</td>
<td>Severe fragmentation</td>
<td>Isolated populations</td>
</tr>
<tr>
<td>Regeneration/recruitment</td>
<td>No regeneration or recruitment</td>
<td>Decline of &gt;50% predicted in next generation</td>
</tr>
<tr>
<td>Genetic variation/integrity</td>
<td>Extremely low</td>
<td>Low</td>
</tr>
</tbody>
</table>

Average vulnerability score 10.0

Rank relative to all U.S. oak species of concern (out of 19) 9

THREATS TO WILD POPULATIONS

High Impact Threats

Genetic material loss — inbreeding and/or introgression: Hybridization is a likely threat, as hybrid swarms are reported surrounding almost all Bluff oak populations. The extent of isolated occurrences also causes concerns of introgression or the complete loss of genotypes as unique pockets disappear (R. Lance pers. comm., 2016).

Moderate Impact Threats

Human use of landscape — agriculture, silviculture, ranching, and/or grazing: On private lands across the floodplains and forests of the Southeast, the vast majority of natural landscape has been severely altered either for agriculture or timber harvesting.³

Human use of landscape — residential/commercial development, mining, and/or roads: Oil exploration and other land disturbances have been documented as causing stress to *Q. austrina* on private land.⁸

Human modification of natural systems — disturbance regime modification, pollution, and/or eradication: A majority of the previously-farmed land in Bluff oak’s range has been abandoned due to poorly drained soils, and has subsequently succumbed to shrubs and woody vines that crowd out *Q. austrina*.⁹

Low Impact Threats

Human use of landscape — tourism and/or recreation: Within state parks, *Q. austrina* undergoes stress from maintenance and recreational disturbances, which decrease the tree’s ability to successfully reproduce. Because some individuals decline visually in response to these disturbances, the chance of removal within frequently-visited parks increases due to aesthetic concerns (R. Lance pers. comm., 2016).

Climate change — habitat shifting, drought, temperature extremes, and/or flooding: Dry-season fires are a rising concern as they increase in the southeastern U.S. In 2016 the National Significant Wildland Fire Potential Outlook predicted “to see a large area of above normal significant fire potential for November and December.” Severe droughts as well as stronger winds have been persisting in fall and winter across the region in response to climate change.⁹
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 ex situ collections reporting this species: | 16 |
| Number of plants in ex situ collections: | 47 |
| Average number of plants per institution: | 3 |
| Percent of ex situ plants of wild origin: | 64% |
| Percent of wild origin plants with known locality: | 97% |

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.

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

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

Figure 5. Quercus austrina in situ occurrence points and ex situ collection source localities. U.S. EPA Level III Ecoregions are colored and labelled. 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.
Land protection: Within the inferred native range of *Quercus austrina*, 13% of the land is covered by protected areas (Figure 7). Although the vast majority of *Quercus austrina* occurrences are on private land where management and future use are uncertain, there are a few well-protected populations within high quality habitat. However, these areas do not capture the wide variety of ecological adaptations present within the species large but fragmented range.

Altamaha Grit outcrops of Georgia, also called sandstone outcrops, house *Quercus austrina* and boast a few conservation lands with high-quality examples; these include Flat Tub Wildlife Management Area and Broxton Rocks, which is a private preserve. Other protected areas in Georgia containing *Q. austrina* include George L. Smith State Park (87 hectares), Charles Harrold Nature Preserve (28 hectares), and Fort Stewart Military Base (162 hectares).

Sustainable management of land: The neighborhood of SouthWood, Florida, keeps all native, mature trees and works to maintain them, including *Q. austrina*.13 George L. Smith State Park is managed by the Georgia Department of Natural Resources, and consists of sandhill habitat that undergoes prescribed fires. Charles Harrold Nature Preserve is a sandhill and wetland depression ecosystem, managed by The Nature Conservancy, and was not fire managed until recently. Fort Stewart Military Base undergoes prescribed burns directed by the U.S. Army.12

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

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

The sporadic distribution of Bluff oak suggests a need for increased conservation attention in the protected areas where small numbers of individuals are known. Where mature specimens of this oak occur, land management should be geared toward recruitment of seedlings. The hazard of damage to mature specimens or their habitat is most significant where there are very few plants extant, therefore a need exists for education of managerial staff. Mechanisms for the protection of valuable populations on private land, such as conservation easements, should also be considered. Additionally, there is a void in the understanding of how local genotypes may differ across the fragmented range of the species. Barring extensive analytical work of the genetic variation, an increased ex situ representation of known populations is recommended.

The taxonomic integrity of this species has been variously treated in the past. Morphological similarity and possible genetic relationship to Q. sinuata is one issue that needs elucidation, particularly in the western half of Bluff oak’s range (Alabama, Mississippi, Arkansas). The slight differences in leaf morphology that appear among plants in the eastern portions of its range suggest there may be distinct genotypes and/or genetic mixing with other Quercus species in local populations. It is likely that Q. austrina is often confused with leaf mimics that occur from hybrid events involving other oak taxa, most notably Q. alba, Q. margarettae, Q. similis, Q. sinuata, and Q. stellata. Plants that are intermediate between typical Q. austrina and other taxa are usually made apparent by differences in early season vestiture. An intensive herbarium study and genetic research could aid in resolving residual taxonomic questions, range confirmations, and perhaps address genetic origin. Subsequent field work and field surveys of the variation would be an aid to both in situ and ex situ conservation efforts.

Conservation recommendations for Quercus austrina

**Highest Priority**
- Population monitoring and/or occurrence surveys
- Sustainable management of land
- Wild collecting and/or ex situ curation
- Research (demographic studies/ecological niche modeling; land management/disturbance regime needs; population genetics; taxonomy/phylogenetics)

**Recommended**
- Land protection
- Education, outreach, and/or training

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Population monitoring and/or occurrence surveys: A few Bluff oak experts have sought the species while carrying out other botanical exploration and land management responsibilities, but no formal occurrence surveys or monitoring programs are currently known (R. Lance pers. comm., 2018).

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

Propagation and/or breeding programs: The Florida Native Plant Society Citrus County Chapter sold Q. austrina at their annual plant sale in 2017. The Florida Association of Native Nurseries’ Urban Forestry Services of Alachua County also offers Q. austrina. Coastal Wildscapes and Georgia Native Plant Society have published a brochure informing landscaping with native plants in coastal Georgia, which includes a ranking of plants based on their availability in nurseries; Bluff oak is ranked as least available compared to other natives.

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

Research: One institution reported conservation genetics research in the conservation action questionnaire, but no other details are currently known.

Education, outreach, and/or training: Four institutions reported this activity in the conservation action questionnaire, but no other details are currently known.

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