Conservation Gap Analysis of Native U.S. Oaks

Species profile: ***Quercus oglethorpensis***

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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:
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*

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Quercus oglethorpensis W.H.Duncan

Synonyms: N/A **Common Names:** Oglethorpe oak

Species profile co-author: Matt Lobdell, The Morton Arboretum

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Matt Lobdell

DISTRIBUTION AND ECOLOGY

Quercus oglethorpensis, or Oglethorpe oak, has a disjointed distribution across the southern U.S. Smaller clusters of localities exist in northeastern Louisiana, southeastern Mississippi, and southwestern Alabama, and a more extensive and well-known distribution extends from northeastern Georgia across the border into South Carolina. There has been relatively little research regarding the full distribution of this species, as it wasn't described until 1940 and has only recently received attention from the botanic community. From 1975 to 2013, about seven new localities were discovered. Oglethorpe oak is known to be locally uncommon, and previous sites have recently been found unoccupied upon the following visit (M. Lobdell pers comm., 2017). The species' most vigorous subpopulations exist within the distinctive Piedmont Gabbro Upland Depression Forest (PGUDF) ecosystem. This association consists of a patchy, wet hardwood forest that only occurs on gently sloping or slightly concave upland terrain in Georgia and South Carolina.[1] There is evidence that *Q. oglethorpensis* had a denser population before colonial settlement, but agriculture and other land alterations have restricted its distribution.[2] Across its range, *Q. oglethorpensis* is found in moist, heavy chalk or limestone soils that are rich and contain high clay content. The tree usually reaches about 18 meters, but can grow up to 25 meters in height.[3]

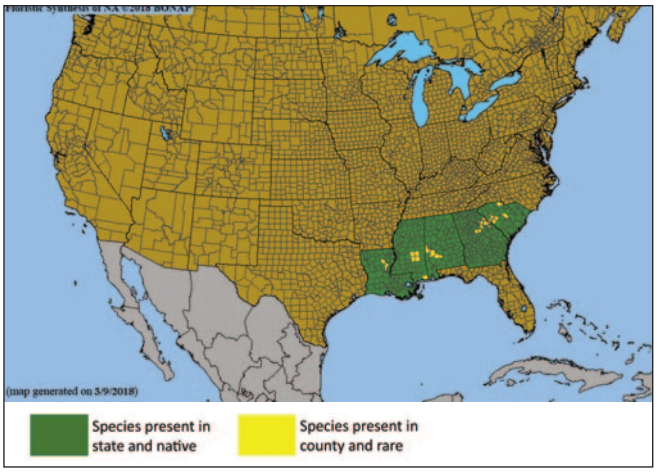


Figure 1. County-level distribution map for *Quercus oglethorpensis*. Source: Biota of North America Program (BONAP).[4]

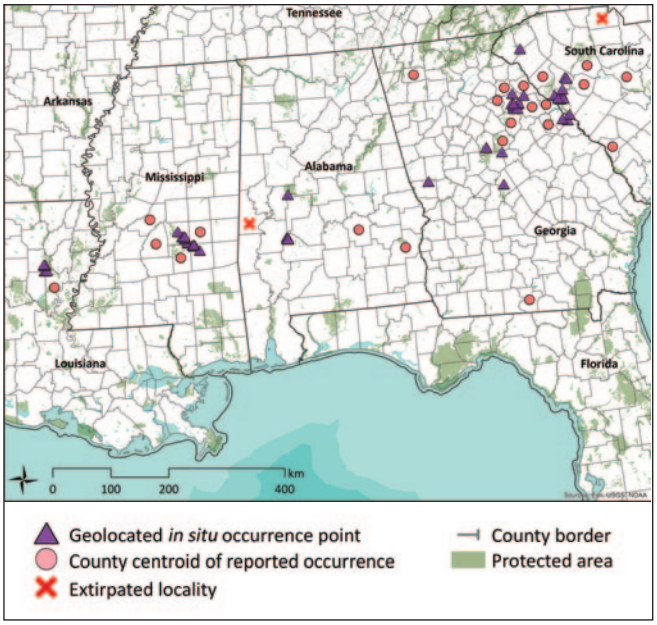


Figure 2. Documented *in situ* occurrence points for *Quercus oglethorpensis*. Protected areas layer from U.S. Geological Survey Gap Analysis Program (GAP) 2016 Protected Areas Database of the U.S. (PAD-US).[5]

VULNERABILITY OF WILD POPULATIONS

Table 1. Scoring matrix identifying the most severe demographic issues affecting *Quercus oglethorpensis*. 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						
	Emergency Score = 40	**High** Score = 20	**Moderate** Score = 10	**Low** Score = 5	**None** Score = 0	**Unknown** No score	**Score**
Population size	< 50	< 250	< 2,500	< 10,000	> 10,000	Unknown	10
Range/endemism	Extremely small range or 1 location	EOO < 100 km² or AOO < 10 km² or 2-4 locations	EOO < 5,000 km² or AOO < 500 km² or 5-9 locations	EOO < 20,000 km² or AOO < 2,000 km² or 10+ locations	EOO > 20,000 km² or AOO > 2,000 km²	Unknown	5
Population decline	Extreme	>= 80% decline	>= 50% decline	>= 30% decline	None	Unknown	5
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	20
Genetic variation/ integrity	Extremely low	Low	Medium	High	Very high	Unknown	10
						Average vulnerability score	11.7
						Rank relative to all U.S. oak species of concern (out of 19)	7

THREATS TO WILD POPULATIONS

High Impact Threats

Human modification of natural systems — disturbance regime modification, pollution, and/or eradication: Damming and flooding in some areas have changed the floodplain ecosystems on which Oglethorpe oak relies.[6]

Moderate Impact Threats

Human use of landscape — agriculture, silviculture, ranching, and/or grazing: Land use changes have posed a large threat to *Q. oglethorpensis* in the past, but most areas suitable for agriculture or silviculture have already been cleared, leaving wetter areas or roadside occurrences remaining.[2,7]

Human use of landscape — residential/commercial development, mining, and/or roads: Forest clearing for urban and suburban development shrunk the distribution of *Q. oglethorpensis*, but most areas suitable for development have already been converted.[2,7]

Climate change — habitat shifting, drought, temperature extremes, and/or flooding: Dry-season fires render concern, since Oglethorpe oak seedlings and saplings are not fire-tolerant. Extreme drought and flooding have recently been experienced by the region, and further changes due to climate change are expected.[8]

Genetic material loss — inbreeding and/or introgression: Genetic research has found that some populations of *Q. oglethorpensis* exhibit moderate to high levels of inbreeding, compared to other wind-pollinated species.[9] As with other rare oaks, genetic introgression may also be a problem.

Pests and/or pathogens: Changes in the hydrology of the region have led to insubstantial regeneration and serious losses due to chestnut blight (*Cryphonectria parasitica*), which cannot survive in wetland sites but attacks upon drainage.[8] In Louisiana, there is initial evidence of disease caused by a member of the Botryosphaeriaceae family. A sample was collected by Adam Black and cultured at the University of Florida; further collection from the infected *Q. oglethorpensis* population has been planned, to confirm the pathogen's identity (M. Lobdell pers. comm., 2018).

Low Impact Threats

Human modification of natural systems — invasive species competition: Invasive plants such as Japanese honeysuckle (*Lonicera japonica*), Autumn olive (*Elaeagnus umbellata*), and Chinese privet (*Ligustrum sinense*) compete with seedlings.[6] In transitional forests where the species occurs, including some districts of Bienville National Forest, successional species such as Liquidambar styraciflua and Nyssa sylvatica may also be a source of competition by shading out establishing seedlings and saplings (M. Lobdell pers. comm., 2018).

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:	30
Number of plants in *ex situ* collections:	392
Average number of plants per institution:	13
Percent of *ex situ* plants of wild origin:	93%
Percent of wild origin plants with known locality:	98%

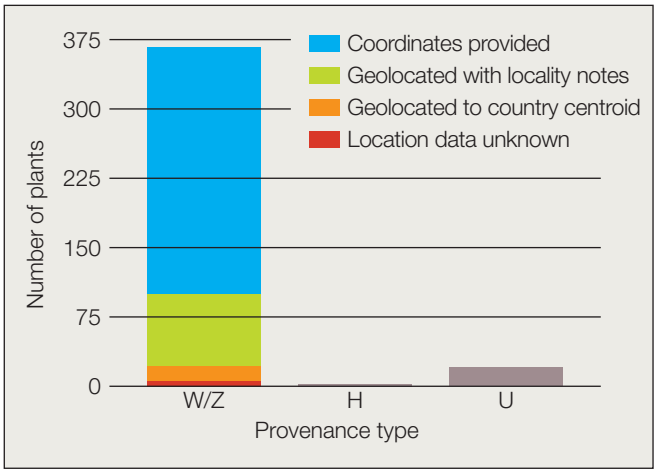


Figure 3. Number and origin of *Quercus oglethorpensis* plants in *ex situ* collections. Provenance types: W = wild; Z = indirect wild; H = horticultural; U = unknown.

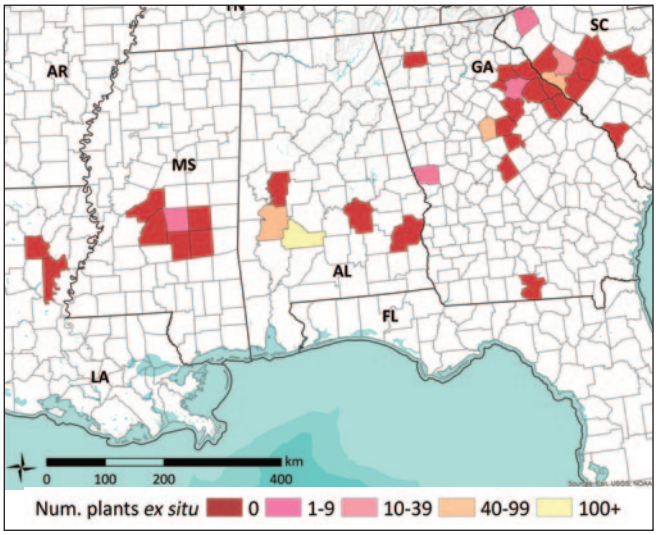


Figure 4. *Quercus oglethorpensis* counties of *in situ* occurrence, reflecting the number of plants from each county in *ex situ* collections.

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:	38%
Ecological coverage:	33%

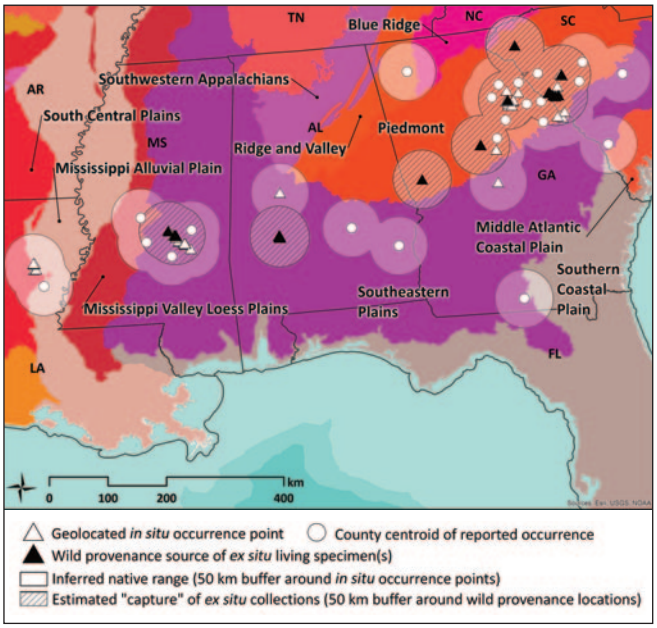


Figure 5. *Quercus oglethorpensis in situ* occurrence points and *ex situ* collection source localities. U.S. EPA Level III Ecoregions are colored and labelled.[10] County centroid is shown if no precise locality data exist for that county of occurrence. Email treeconservation@mortonarb.org for information regarding specific coordinates.

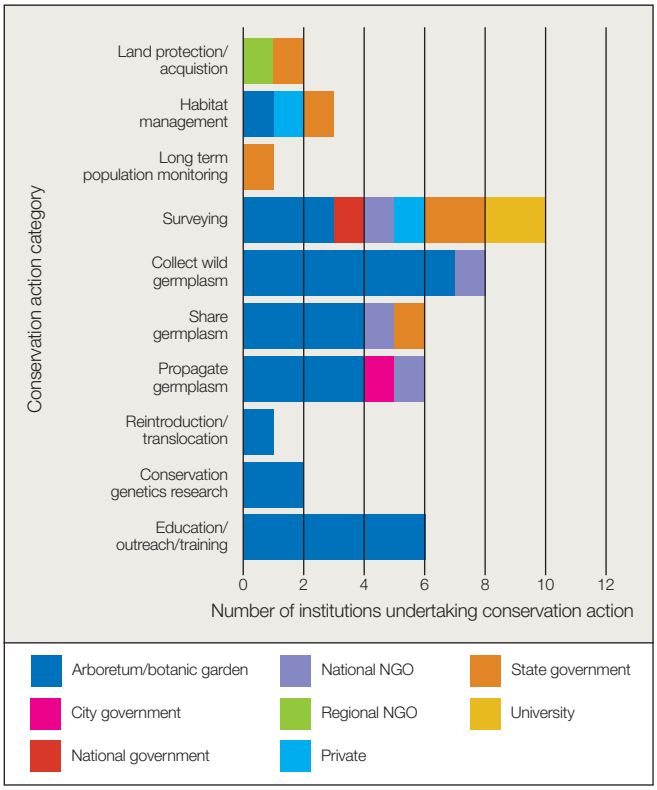


Figure 6. Number of institutions reporting conservation activities for *Quercus oglethorpensis* grouped by organization type. Twenty-four of 252 institutions reported activities focused on *Q. oglethorpensis* (see Appendix D for a list of all responding institutions).

Land protection: Within the inferred native range of *Q. oglethorpensis*, 9% of the land is covered by protected areas (Figure 7). Some relatively healthy populations are known in protected areas, but the majority of Oglethorpe oak habitat is privately owned.

The non-profit regional land trust Broad River Watershed Association preserves natural areas within Georgia's Broad River basin and lists *Q. oglethorpensis* as a rare species within the area.[11] Oglethorpe oak is also known from Bienville National Forest in Mississippi, Oconee National Forest and George L. Smith State Park in Georgia, and Sumter National Forest in South Carolina (M. Lobdell pers. comm., 2017).

Sustainable management of land: Three protected areas are known to currently monitor and manage *Q. oglethorpensis* within their boundaries, performing controlled burns and selective clearing; these include Bienville National Forest, Oconee National Forest, and Sumter National Forest (M. Lobdell pers. comm., 2017). The Georgia Department of Natural Resources manages George L. Smith State Park, approximately 87 hectares, with prescribed fire.[12]

Population monitoring and/or occurrence surveys: A 2014 floristic inventory of the Piedmont Gabbro Upland Depression Forests was administered at three sites, approximately 600 acres each, in Oconee National Forest in Jasper County, Georgia. The survey documented 541 vascular plant species in 319 genera and 111 families, including *Q. oglethorpensis*.[1] Extensive scouting was performed before and during germplasm collections in 2017, lead by The Morton Arboretum, in partnership with Tulsa Botanic Garden and Peckerwood Garden, and supported by a 2017 APGA-USFS Tree Gene Conservation grant. These surveys continued in 2018 (M. Lobdell pers. comm., 2018).[13]

Wild collecting and/or *ex situ* curation: With funding from a 2015 APGA-USFS Tree Gene Conservation Partnership grant, The Morton Arboretum led a collecting trip which gathered a total of 287 acorns from 28 populations of *Q. oglethorpensis* in Alabama, Georgia, and South Carolina. No fruiting individuals were located in Bienville National Forest, Mississippi, but scion wood was collected for grafting. One fruiting tree was observed in Sumter National Forest (South Carolina), from which about 40 acorns were collected. The population near Catherine, Alabama was the most extensively sampled, with 274 acorns collected. Acorns were propagated at The Morton Arboretum and, following the first growing season, a portion was shipped to three botanic gardens and arboreta with Nationally Accredited Collections of oaks: The Holden Arboretum, Chicago Botanic Garden, and Starhill Forest Arboretum. This distributes the germplasm over an area approximately 635,000 kilometers squared.[14] Another APGA-USFS Tree Gene Conservation Partnership grant was awarded in 2017 for the collection of *Q. oglethorpensis* populations within Mississippi and Louisiana, which were not covered by the first project. Unfortunately, no acorns were found during this expedition (M. Lobdell pers. comm., 2018).[13]

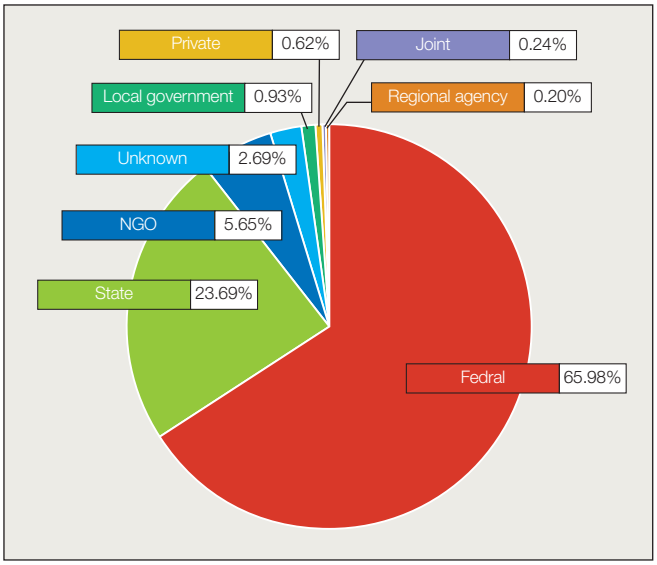


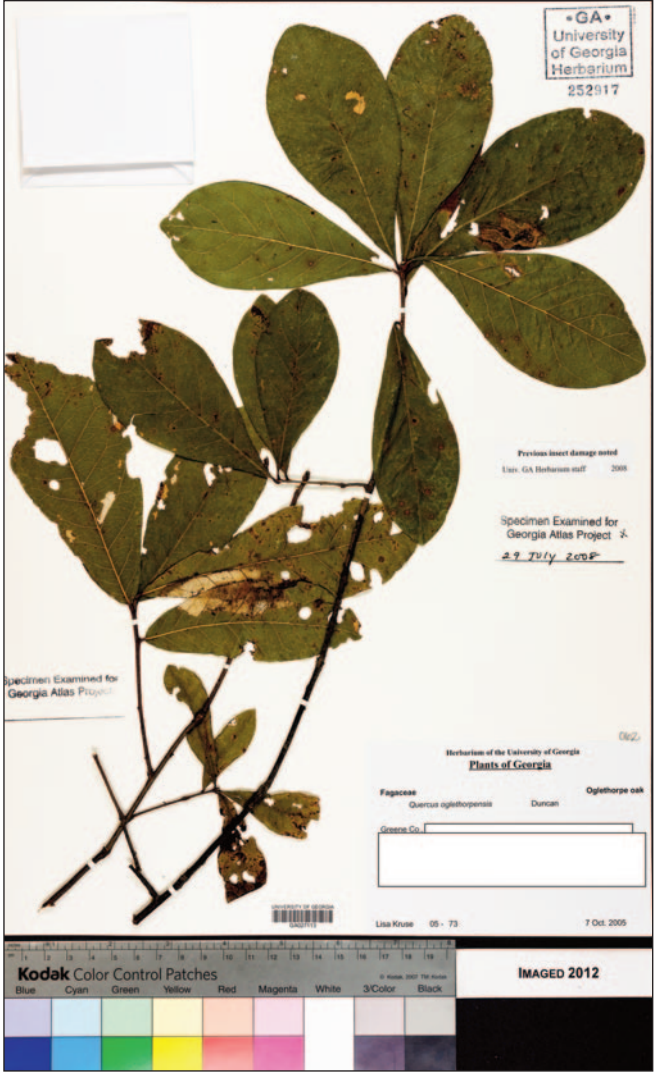
Figure 7. Management type of protected areas within the inferred native range of *Quercus oglethorpensis*. Protected areas data from the U.S. Geological Survey Gap Analysis Program (GAP) 2016 Protected Areas Database of the U.S. (PAD-US).[5]

Propagation and/or breeding programs: Acorns collected during the 2015 expedition are in propagation at four botanic gardens and arboreta within the U.S. "By cultivating and evaluating the species in the collections of botanical gardens and arboreta, a better understanding of its ideal growing conditions will be gained, and the success rate for *Q. oglethorpensis* in cultivation will likely increase."[14] Acorns collected in 2017 are in propagation at The Morton Arboretum. Following germination, a determination will be made as to their species. Resulting *Q. oglethorpensis* seedlings will be divided among Bartlett Tree Research Laboratories and Arboretum, Chicago Botanic Garden, The Morton Arboretum, Peckerwood Garden, Polly Hill Arboretum, US National Arboretum, and Tulsa Botanic Garden.[13]

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

Research: Oglethorpe oak coexists with many other rare species and has experienced a significant decrease in healthy habitat, prompting ecosystem-focused research. For example, a floristic inventory and site quality assessment was completed for the Piedmont Gabbro Upland Depression Forests plant association, which is ranked as globally Imperiled by NatureServe. This habitat is endemic to a few scattered locations in the Piedmont regions of Georgia and South Carolina, and houses *Q. oglethorpensis*.[1] Research focused on propagation and provenance tests of Oglethorpe oak is underway through a APGA-USFS Tree Gene Conservation Partnership grant.[14]

Wood (2018) sampled populations of *Q. oglethorpensis* in South Carolina, Georgia, Alabama, Mississippi and Louisiana to examine population structure and compare the genetic diversity found among *in situ* populations versus *ex situ* collections. He found that Bienville National Forest had the highest allelic diversity, Monticello Glades and Buffalo Mills Road harbored the most unique alleles, and Louisiana harbors the only two populations that did not show significant inbreeding. In his examination of all possible *ex situ* sampling combinations, Wood showed that "to capture 90% of the globally common alleles would require collecting samples from between 15 and 20 trees from at least 6 of the 7 populations, while capturing 90% of locally common alleles would require 5 trees from 6 of the 7 populations." At the start of the study, Wood found that *ex situ* collections contained less than 63% of the total alleles found in wild samples of Oglethorpe oak from across its range. After collecting samples for the study and distributing them to *ex situ* collections, genetic capture within *ex situ* collections rose to 86%.[9]



Education, outreach, and/or training: Oglethorpe oak is rarely available from nurseries, but plants can be obtained from Woodlanders, Inc nursery.[15]

Species protection policies: Oglethorpe oak is listed as Threatened in Georgia, "rare" in South Carolina, and S1 (state-level Critically Imperiled) in Louisiana. One example of the effect state listing has in Georgia can be seen in the environmental review for a proposed hydroelectric dam project; the review reports the presence of *Q. oglethorpensis* and any effects the company may have on its population, which is required before moving forward with the project.[16] Athens-Clarke County has created a Tree Species List that aims to "support the development code, site planning and design activities for tree conservation and establishment, and tree maintenance planning and decision-making;" this list includes *Q. oglethorpensis*.[17]

PRIORITY CONSERVATION ACTIONS

Further conservation efforts for Oglethorpe oak should be two-fold, focusing on both *in situ* and *ex situ* efforts. Floristic surveys should continue on a semi-regular basis with the goal of locating potentially undocumented populations, as well as confirming the continued existence of narrow disjuncts. Reported losses of populations such as those in Sumter County, Alabama, a mere few years after their initial documentation, indicates the urgency of conservation activities in many sites, particularly those located on private or unprotected land. Depending on the site, a combination of various conservation activities could be pursued: acquiring land for protection; engaging landowners and land managers in training regarding Oglethorpe oak identification and/or appropriate habitat management; providing resources for sustainable management of land within areas already protected; reinforcing or translocating populations that are dwindling or threatened by land use changes, especially those with unique genetic diversity.

The relative hardiness of the species as demonstrated by cultivation at The Morton Arboretum (Lisle, IL) suggests *ex situ* conservation could also play a valuable role in the long-term preservation of the species. Material in cultivation is still heavily skewed towards specimens with provenance of the type locality in Oglethorpe County, Georgia or large populations in Greenwood County, South Carolina. Further collection of material from the western portion of the species distribution would be valuable. In addition, it may prove useful to engage in ecological niche and climate change modeling for *Q. oglethorpensis*. These data could help identify areas for further scouting that may harbor unknown populations of the species, as well as aid in planning for future habitat changes, which would inform current *in situ* and *ex situ* conservation activities.

Conservation recommendations for *Quercus oglethorpensis*

Highest Priority

- Population monitoring and/or occurrence surveys
- Sustainable management of land
- Wild collecting and/or *ex situ* curation

Recommended

- Education, outreach, and/or training
- Land protection
- Reintroduction, reinforcement, and/or translocation
- Research (climate change modeling; demographic studies/ecological niche modeling; land management/disturbance regime needs; pests/pathogens; restoration protocols/guidelines)

REFERENCES

1. **Sewell, S. Y., & Zomlefer, W. B. (2014).** Floristics of Piedmont Gabbro Upland Depression Forests in Jasper County, Georgia. Castanea, 79(3), 195-220. doi:10.2179/14-019
2. **Haehnle, G. G., & Jones, S. M. (1985).** Geographical distribution of *Quercus oglethorpensis*. *Castanea*, 50(1), 26-31. Retrieved from https://www.jstor.org/stable/4033102
3. **Louisiana Department of Wildlife and Fisheries. (n.d.).** *Quercus oglethorpensis* Duncan: Rare plant fact sheet PDFAG051M0. Natural Heritage Program. Retrieved from http://www.wlf.louisiana.gov/sites/default/files/pdf/fact_sheet_plant/31897-Quercus%20oglethorpensis/quercus_oglethorpensis.pdf
4. **Kartesz, J. T. (2018).** The Biota of North America Program (BONAP). Taxonomic Data Center, Floristic Synthesis of North America, Version 1.0. Chapel Hill, NC. Retrieved from http://www.bonap.net/tdc
5. **U.S. Geological Survey, Gap Analysis Program (GAP). (2016, May).** Protected Areas Database of the United States (PAD-US). Version 1.4 Combined Feature Class. Retrieved from https://gapanalysis.usgs.gov/padus/data/download/
6. **Chafin, L. G. (2007).** *Field guide to the rare plants of Georgia*. Athens, GA: The State Botanical Garden of Georgia and University of Georgia Press.
7. **Lobdell, M., & Thompson, P. (2017).** *Ex-situ* conservation of *Quercus oglethorpensis* in living collections of arboreta and botanical gardens. In Sniezko, R. A., Man, G., Hipkins, V., Woeste, K., Gwaze, D., Kliejunas, J. T., & McTeague, B. A. (Tech. coords.), *Gene conservation of tree species—banking on the future workshop proceedings* (Gen. Tech. Rep. PNW-GTR-963). Portland, OR: Pacific Northwest Research Station, Forest Service, U.S. Department of Agriculture. Retrieved from https://www.fs.usda.gov/treesearch/pubs/55112
8. **Coder, K. D. (2003, December).** *Oglethorpe oak: Sunset of a species*. Athens, GA: University of Georgia Warnell School of Forest Resources.
9. **Wood, J. (2018).** *Conservation genetics and* ex situ *management for living collections for endangered plants* (Unpublished master's thesis). Northwestern University & Chicago Botanic Garden.
10. **U.S. EPA Office of Research & Development. (2013, April).** Ecoregions of the Conterminous United States. National Health and Environmental Effects Research Laboratory (NHEERL). Retrieved from ftp://ftp.epa.gov/wed/ecoregions/us/us_eco_l4.zip
11. **Broad River Watershed Association. (2013).** Trees/shrubs. Retrieved from http://www.brwa.org/natural-guide/plants/plants—-trees/
12. **Long, J. M., & Schenk, J. (2017).** *Comparative floristic studies of Georgian Sandhill ecosystems reveals a dynamic composition of endemics and generalists*. Georgia Southern University Honors Program Theses. 247. Retrieved from http://digitalcommons.georgiasouthern.edu/honors-theses/247
13. **Lobdell, M. (2017).** *APGA/USFS Tree Gene Conservation Partnership report on 2017 scouting and collection efforts targeting* Quercus oglethorpensis. Lisle, IL: The Morton Arboretum. Retrieved from https://www.publicgardens.org/sites/default/files/2017%20Quercus%20oglethorpensis%20II%20report.pdf
14. **Lobdell, M., & Thompson, P. (2015, December).** *APGA/USFS Tree Gene Conservation Partnership: Report on scouting and collection efforts targeting* Quercus oglethorpensis. Retrieved from https://publicgardens.org/sites/default/files/images/documents/OglethorpeReport_LobdellMandThompsonP_2015-12-17.pdf
15. **Coombes, A. J., & Coates, W. N. (1997).** Oglethorpe and the Oglethorpe oak. *Arnoldia*, (Summer), 25-30. Retrieved from http://arnoldia.arboretum.harvard.edu/pdf/articles/1997-57-2-oglethorpe-and-the-oglethorpe-oak.pdf
16. **Georgia Power. (2015, February).** Pre-application document: Wallace Dam Hydroelectric Project FERC, project number 2413.
17. **Athens-Clarke County. (n.d.).** The Athens-Clarke County tree species list. Retrieved from https://www.athensclarkecounty.com/DocumentView.aspx?DID=281