

# ***Ex-situ* Conservation of *Quercus oglethorpensis* in Living Collections of Arboreta and Botanical Gardens<sup>1</sup>**

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## **Abstract**

*Quercus oglethorpensis* (Oglethorpe oak) is an endangered species native to the southeastern United States. It is threatened by land use changes, competition, and chestnut blight disease caused by *Cryphonectria parasitica*. The species is distributed sparsely over a linear distance of ca. 950 km. Its range includes several disjunct populations potentially harboring unique genetic diversity or adaptive variation. Protected populations in the Bienville National Forest (Mississippi), Oconee National Forest (Georgia), and Sumter National Forest (South Carolina) are regularly monitored and managed through a combination of techniques including burn management and selective clearing. Recently, several additional populations were discovered in Alabama, primarily along rights-of-way or on private land where they should be considered vulnerable or at risk of extirpation. One documented population in Sumter County, Alabama has already been lost to land clearing or logging activities. Traditional techniques such as seed banking are insufficient for *ex-situ* conservation of *Q. oglethorpensis* because it has recalcitrant seeds. It has been demonstrated, however, that the species is suitable for cultivation in much of the United States, allowing for the possibility of *ex-situ* conservation in the living collections of arboreta and botanical gardens.

In 2015, through a joint venture between the U.S. Department of Agriculture Forest Service and American Public Gardens Association, seed and/or samples of scion wood were collected from populations of Oglethorpe oak in Mississippi, Alabama, Georgia, and South Carolina and propagated at The Morton Arboretum (Lisle, Illinois). From there, they will be distributed to five arboreta and botanical gardens: Chicago Botanic Garden (Glencoe, Illinois), Starhill Forest Arboretum (Petersburg, Illinois), Holden Arboretum (Willoughby, Ohio), Donald E. Davis Arboretum of Auburn University (Auburn, Alabama), and Moore Farms Botanical Garden (Lake City, South Carolina). Through cultivation in the Nationally Accredited Collections™ of these arboreta and botanical gardens, genetically diverse and representative germplasm of *Q. oglethorpensis* will be preserved and potentially utilized in future reintroduction efforts.

## **Introduction**

*Quercus oglethorpensis* (Oglethorpe oak) is a species of conservation concern occurring in sparse, relatively isolated populations located within the southeastern United States. When put in the context of other eastern North American tree species, *Q. oglethorpensis* is a rather recent discovery, remaining undescribed until 1940. Originally mistaken for a southern disjunction of *Q. imbricaria*, closer inspection revealed *Q. oglethorpensis* to be a distinct species in the white oak group (*Quercus* sect. *Quercus*). The species was named for Oglethorpe County, Georgia, and thus indirectly named for James Oglethorpe, the founder of the State of Georgia (Coombes and Coates 1997). It can generally be distinguished from associated *Quercus* spp. by its entire to sparse or irregularly lobed leaves lacking bristles or awns (fig. 1), though confusion with *Q. durandii* may be possible without examination of reproductive material.

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Figure 1—Foliage of *Quercus oglethorpensis* as observed in Bienville National Forest; July 2015.

Subsequent floristics (Haehnle and Jones 1985, Marx and Thomas 1975) revealed a disjunct population of *Q. oglethorpensis* in Caldwell Parish, Louisiana, as well as additional populations in Georgia and South Carolina. Once the Caldwell Parish site was documented, an effort to locate the species on similar soil types in Mississippi was initiated, and three populations were discovered in Bienville National Forest (Wiseman 1987). In 1998, a population of the species was discovered in Sumter County, Alabama, with additional Alabama populations (fig. 2) located in Marengo and Wilcox counties in 2013 (Keener et al. 2016).



Figure 2—Habitat of *Quercus oglethorpensis* west of Catherine, Alabama (Marengo and Wilcox counties); July 2015.

Although the distribution of *Q. oglethorpensis* was found to be broader than initially realized, it still exhibits a fragmented distribution such that it is locally uncommon. It exhibits some susceptibility to chestnut blight disease, however the greatest threat facing the species is likely land clearing, particularly that which occurred prior to its description (Coombes and Coates 1997). It is listed as Endangered B1+2ce on the IUCN (International Union for Conservation of Nature) Red List, defined as a species

which is severely fragmented or known to exist at no more than five locations, with continuing decline inferred, observed or projected in area, extent and/or quality of habitat, and number of mature individuals (Nixon et al. 1998). It is not federally ranked as endangered, though is considered threatened in the state of Georgia.

Populations located in Sumter National Forest (South Carolina), Oconee National Forest (Georgia), and Bienville National Forest (Mississippi) are conserved and managed *in situ* by the U.S. Department of Agriculture Forest Service (USDA FS). Management includes prescribed burning or “release,” in which competing, rapidly growing woody species such as *Liquidambar styraciflua* and *Nyssa sylvatica* are cut back from the vicinity of *Q. oglethorpensis* saplings to allow the latter to establish (D. Elsen, Bienville National Forest, personal communication, 2015).

Interest in horticultural cultivation of *Q. oglethorpensis* has been minimal. Several United States arboreta and botanic gardens began growing the species in 1980, following distribution of seed collected in Greenwood County, South Carolina by the Clemson University Forestry Department. Cultivation of Oglethorpe oak at The Morton Arboretum (Lisle, Illinois) demonstrated unexpected cold-tolerance for a species native to the United States southeast (fig. 3). It may be propagated either by seed or by grafting onto a compatible rootstock such as *Q. alba*, *Q. bicolor*, or *Q. robur*.



Figure 3—*Quercus oglethorpensis* in cultivation at The Morton Arboretum (Lisle, Illinois); fall 2007.

*Quercus oglethorpensis* has never been common in the nursery trade, though it has been available from specialty providers such as Woodlanders, Inc. (Aiken, South Carolina) and Heritage Seedlings (Salem, Oregon). The species has also been trialed in Europe, with an introduction occurring at Hillier Nurseries in 1978 (Hillier and Lancaster 2014). Its performance in Britain has been poor, likely due to insufficient summer heat for hardening of growth (Coombes and Coates 1997). All plants in cultivation worldwide appear to trace their lineage to Georgia or South Carolina populations, with those in Louisiana, Mississippi, and Alabama apparently unrepresented.

As with many *Quercus* taxa, *ex-situ* conservation through seed banking is not currently feasible for this species because its seed (acorns) are recalcitrant. Conservation through living collections of botanical gardens and arboreta is likely to provide more success, particularly when considering demonstrated success of cultivation in several regions of the United States.

## Summary of Fieldwork

A concerted effort to collect seeds and/or scion wood from populations of *Q. oglethorpensis* for the purpose of *ex-situ* conservation was initiated in 2015 as a pilot project of the American Public Gardens



Association and USDA FS's Tree Gene Conservation Program. Populations in Mississippi, Alabama, and South Carolina were targeted and visited in late July and early August for verification and observation of seed production, and again in mid to late October for seed collection when applicable.

Populations in Bienville National Forest (Mississippi) were located and documented with herbarium vouchers (fig. 4). All individuals located appeared to be in good health with no significant threats noticed save competition from associated species. Fruit production was not observed, so a return visit that fall for seed collection was deemed unnecessary. Later that winter, USDA FS staff collected and sent scion wood to The Morton Arboretum for propagation by grafting.

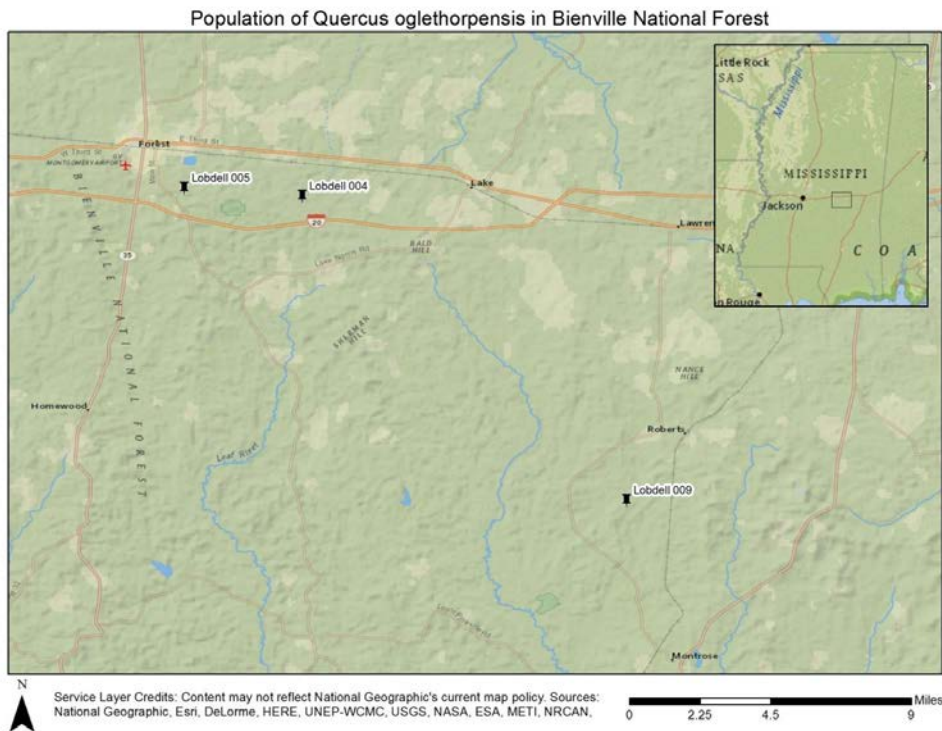


Figure 4—Map depicting *Quercus oglethorpensis* locations in Scott and Jasper counties, Mississippi.

*Quercus oglethorpensis* was first documented to occur in Alabama at a location identified by Al Schotz in Sumter County along the bottomlands of the Alamuchee Creek. These trees, which were also visited in summer, 2015, were apparently extirpated by logging activity in the area. Attempts by Al Schotz to relocate the original specimens or outlying members of the population failed, as did attempts by Wayne K. Webb in 2012 and 2013. The population west of Catherine, Alabama spanning Marengo and Wilcox counties is much more robust, consisting of at least 60 individuals. Multiple individuals were located and documented with herbarium specimens (fig. 5). Many were also observed producing suitable quantities of fruit. These were revisited in the fall for seed collection. Despite prolific seed production, seedling recruitment was virtually nonexistent in this population.

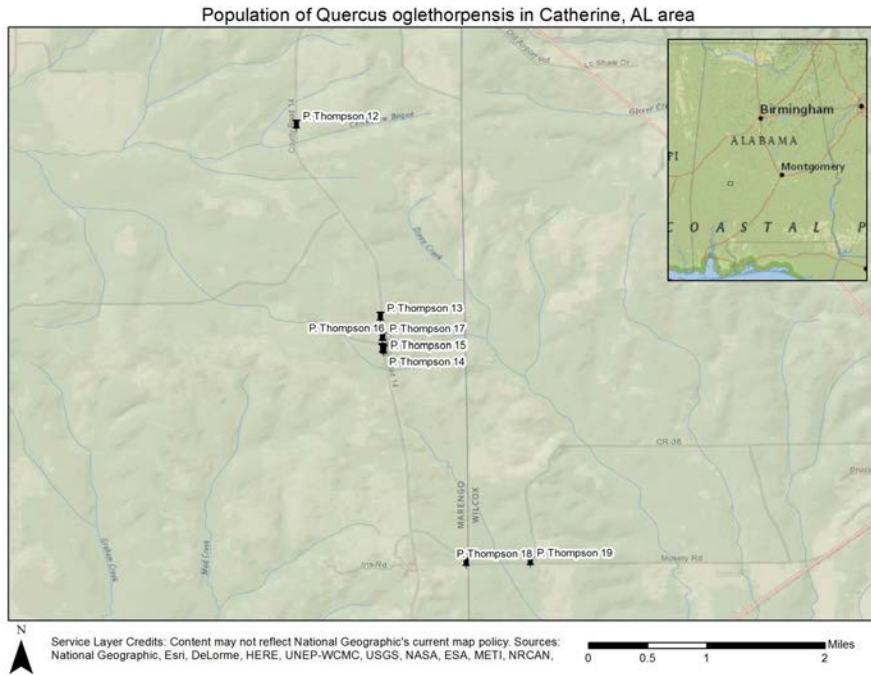


Figure 5—Map depicting *Quercus oglethorpensis* locations in Marengo and Wilcox Counties, Alabama.

Across the Sumter National Forest in South Carolina, the species appeared to be in good health and was more locally common than in Mississippi or Alabama. Several locations were visited throughout the forest and documented with herbarium vouchers (fig. 6), but only one was observed with sufficient fruit production to justify a second visitation in the fall.

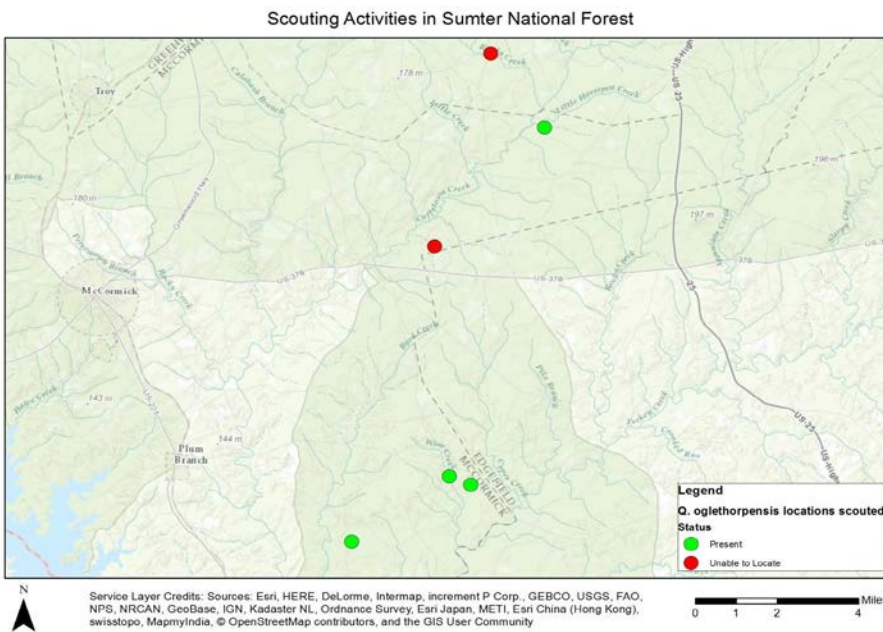


Figure 6—Map depicting *Quercus oglethorpensis* sites scouted in Sumter National Forest.

A search was also undertaken for a reported population in York County, South Carolina likely representing the most northern distribution of the species. It could not be located after several hours of searching. The population is likely extirpated (fig. 7).

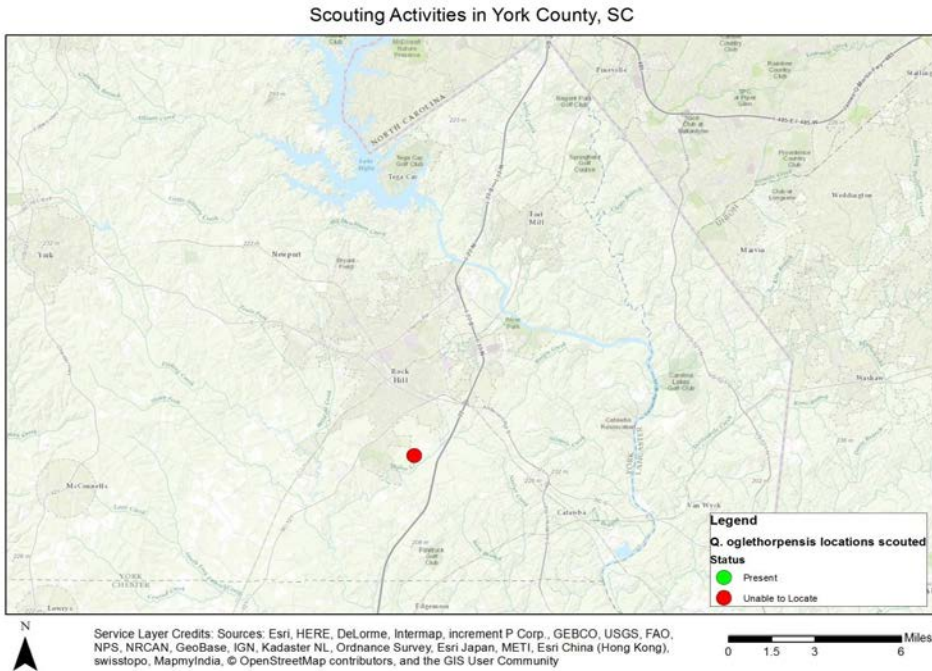


Figure 7—Map depicting potentially extirpated *Quercus oglethorpensis* site scouted in York County, South Carolina.

A total of 18 herbarium vouchers were collected during this project. They have been deposited in the United States National Arboretum Herbarium, with the duplicates held in The Morton Arboretum Herbarium. Though poor fruit production in Bienville and Sumter National Forests prevented extensive sampling in those locations, 281 seeds were collected as part of this effort, largely representing the population west of Catherine, Alabama (table 1). In January, 2016, USDA FS Staff from the Bienville National Forest sent cut stems from four individuals in Scott County, sufficient for a total of 35 scions to be grafted.

**Table 1—Collections made from *Q. oglethorpensis* individuals (#V and #S indicate number of vouchers and seeds collected from each individual)**

Project #	Collection #	#V	#S	State	County	Latitude	Longitude
MS-Sco-A-1	M. Lobdell 4	2	0	MS	Scott	32.33903	-89.40681
MS-Sco-B-1	M. Lobdell 5	2	0	MS	Scott	32.34278	-89.46128
MS-Jas-A-1	M. Lobdell 9	2	0	MS	Jasper	32.19828	-89.25672
SC-McC-A-1	M. Lobdell 14	2	0	SC	McCormick	33.97656	-82.103
SC-McC-B-1	M. Lobdell 16	2	0	SC	McCormick	33.83528	-82.18683
SC-McC-B-1	PCC15-SEUS086	0	7	SC	McCormick	33.83511	-82.18689
AL-Mar-A-1	P. Thompson 12	1	36	AL	Marengo	32.23148	-87.54363
AL-Mar-A-2	P. Thompson 13	1	36	AL	Marengo	32.20761	-87.53332
AL-Mar-A-3	P. Thompson 14	1	13	AL	Marengo	32.20372	-87.53307
AL-Mar-A-4	P. Thompson 15	1	36	AL	Marengo	32.20354	-87.5329
AL-Mar-A-5	P. Thompson 16	1	36	AL	Marengo	32.20512	-87.53304
AL-Mar-A-6	P. Thompson 17	1	9	AL	Marengo	32.20504	-87.53304
AL-Mar-A-7	P. Thompson 18	1	36	AL	Marengo	32.17713	-87.52282
AL-Wil-A-1	P. Thompson 19	1	36	AL	Wilcox	32.17725	-87.51493

## Propagation and Distribution

Collected seeds were placed in germination flats containing 50 percent germination mix and 50 percent potting mix. Seed was warm stratified for 2 months (November 2015 to January 2016), then cold stratified for 4 months (January 2016 to May 2016). Germination was as low as 29 percent (two of seven seeds) for acorns collected from the ground in McCormick County, South Carolina, to as high as 100 percent for acorns collected from one individual west of Catherine, Alabama. A total of 218 out of 281 seeds germinated, with a mean germination percentage of 78 percent when considering all seed collections (table 2).

**Table 2—Germination rates of acorns collected during project (accession numbers are of The Morton Arboretum)**

Accession #	Project #	Sown (N)	Emerged (N)	Germination (%)
644-2015	AL-Mar-A-1	36	30	83
645-2015	AL-Mar-A-2	36	23	64
646-2015	AL-Mar-A-3	13	13	100
647-2015	AL-Mar-A-4	36	35	97
648-2015	AL-Mar-A-5	36	33	92
649-2015	AL-Mar-A-5	36	25	69
650-2015	AL-Mar-A-6	9	3	33
651-2015	AL-Mar-A-7	36	31	86
652-2015	AL-Wil-A-1	36	23	64
717-2015	Sc-McC-B-1	7	2	29
Total		281	218	78

In March, 2016, scions were grafted via the side-veneer method onto *Q. oglethorpensis* understock received from Heritage Seedlings (fig. 8). Grafts were waxed and callused in a tube for approximately 5 weeks. Upon removal from the tube and subsequent transplanting 1 month later, 28 of 35 attempted grafts (80 percent) appeared to have taken (table 3).



Figure 8—Side veneer graft of *Q. oglethorpensis* scions onto rootstock of the same species. The Morton Arboretum; June 2016.



**Table 3—Success of side veneer grafts made in 2016; all scions from Scott County, Mississippi (accession numbers are of The Morton Arboretum)**

Accession #	Attempts (N)	Takes (N)	Success (%)
1-2016	5	4	80
2-2016	7	7	100
3-2016	14	10	71
4-2016	9	7	78
Total	35	28	80

Seedlings and scions from this project will be grown in the collections of The Morton Arboretum (Lisle, Illinois), Chicago Botanic Garden (Glencoe, Illinois), Starhill Forest Arboretum (Petersburg, Illinois), Donald E. Davis Arboretum (Auburn, Alabama), Moore Farms Botanical Garden (Lake City, South Carolina), and Holden Arboretum (Willoughby, Ohio). Shipment of seedlings to these institutions will occur in early 2017 (fig. 9).



Figure 9—Seedlings of *Quercus oglethorpensis* in early production at The Morton Arboretum in June, 2016.

## Conclusions

Despite low fruit production by many populations in 2015, this project was largely successful in terms of acquiring propagules of *Q. oglethorpensis* for *ex-situ* conservation. The populations West of Catherine, Alabama and in Bienville National Forest will likely be adequately represented in cultivation barring production failure. Additional seed collections from the latter population may be desirable if the plants grafted during this project exhibit graft incompatibility later. Collection of seed or scion wood from the population in Caldwell Parish, Louisiana would also be desirable, as germplasm from there does not appear to be represented in cultivation at all.

Of further interest is the long-term performance of *Q. oglethorpensis* in a horticultural setting. By cultivating and evaluating the species in the collections of botanical gardens and arboreta, a better understanding of its preferred growing conditions will be gained, and the success rate for *Q. oglethorpensis* in cultivation will likely increase. The potential also exists for cultivated plants to be utilized for reintroduction efforts where appropriate. Furthermore, interpretive and other educational activities occurring at botanical gardens and arboreta could increase awareness of the species, ultimately supporting further conservation efforts.

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