Conservation Gap Analysis of Native U.S. Oaks

Species profile: ***Quercus inopina***

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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 inopina Ashe

Synonyms: N/A **Common Names:** Sandhill oak, Florida oak

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Ron Lance

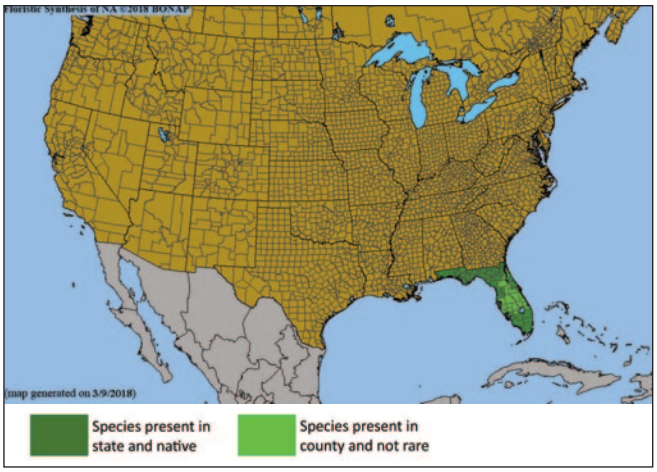

Figure 1. County-level distribution map for *Quercus inopina*. Source: Biota of North America Program (BONAP).[4]

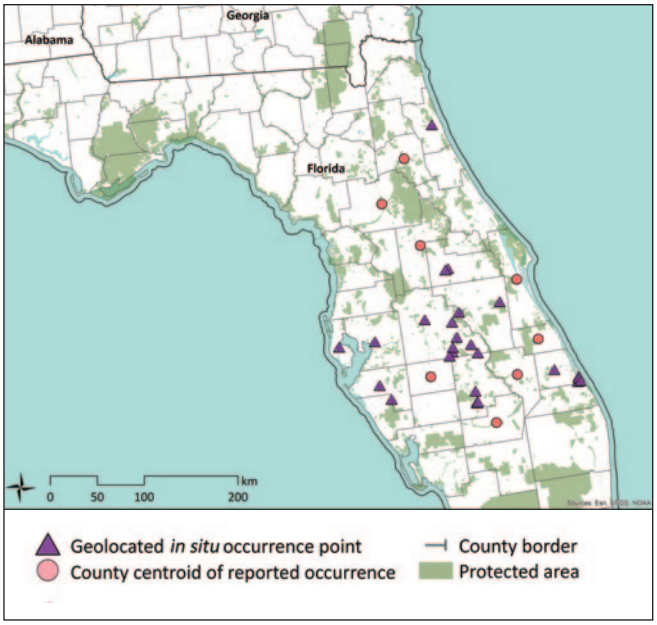

Figure 2. Documented *in situ* occurrence points for *Quercus inopina*. Protected areas layer from U.S. Geological Survey Gap Analysis Program (GAP) 2016 Protected Areas Database of the U.S. (PAD-US).[5]

DISTRIBUTION AND ECOLOGY

Quercus inopina, or Sandhill oak, is endemic to south-central peninsular Florida, U.S. At its discovery in 1929, the species was considered to have characteristics intermediate between those of *Q. myrtifolia* and *Q. arkansana* var. *caput-rivuli* Ashe, though regional floras did not include *Q. inopina* until after the mid-80s.[1] Sandhill oak is abundant in upland ridge scrub, scrubby flatwoods, and open oak scrub communities of central Florida. In these habitats *Q. inopina* dominates along with other xerophytic scrub oaks (*Q. geminata, Q. myrtifolia, Q. chapmanii*), Florida rosemary (Ceratiola ericoides), and occasionally limited Sand pine (Pinus clausa) overstory. Patches of bare white sand and an open canopy are key characteristics of the ecosystem, and represent crucial habitat for the federally threatened Florida Scrub jay (Aphelocoma coerulescens).[2] Intermittent fires are characteristic and necessary to maintain the ecosystem's open canopy. *Quercus inopina* is an evergreen shrub averaging about one meter in height, sometimes reaching up to five meters. It rows clonally from an extensive underground rhizome, sending up unbranched shoots. This underground structure allows for rapid resprouting after fire.[3]

VULNERABILITY OF WILD POPULATIONS

Table 1. Scoring matrix identifying the most severe demographic issues affecting *Quercus inopina*. 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	0
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	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	-
						Average vulnerability score	6.0
						Rank relative to all U.S. oak species of concern (out of 19)	13

High Impact Threats

Human modification of natural systems — disturbance regime modification, pollution, and/or eradication: Many populations have been extirpated due to poor land management. Infrequent, or complete lack of, prescribed burns gives aggressive colonizers the opportunity to dominate. Therefore regular land management is critical for *Q. inopina* (A. Black pers. comm., 2017).

Moderate Impact Threats

Human use of landscape — residential/commercial development, mining, and/or roads: Anthropogenic threats to *Q. inopina* habitat include conversion to residential and commercial uses, which also results in the fragmentation of remaining upland habitat. These developments, in addition to roads and railroads, often restrict the natural dispersal, intensity, and/or frequency of fire.[6]

Low Impact Threats

Human use of landscape — agriculture, silviculture, ranching, and/or grazing: Conversion of habitat to agricultural land threatens *Q. inopina* in some areas (R. Lance pers. comm., 2018).[7]

Human use of landscape — tourism and/or recreation: Scrub habitat is readily damaged by off-road vehicle traffic or even foot traffic, which destroys the delicate ground cover and allows the loose sand to erode.[8]

Climate change — habitat shifting, drought, temperature extremes, and/or flooding: Scrub communities are known to be sensitive to disturbance regime changes, which are altered by a changing climate. Further research is necessary regarding the the effects of climate change on the fluctuation of fire regimes.[9] No climate change projections are known for *Q. inopina* specifically.

Pests and/or pathogens: Because *Q. inopina* is a member of the red oak clade (Sect. Lobatae), it has the potential to be affected by oak wilt, Sudden oak death (SOD), and Goldspotted oak borer.[10,11,12] No serious damage has been reported to-date, though continued monitoring is necessary. Based on SOD's current distribution in California and the environmental conditions at these locations, models "indicated highest potential for establishment [of SOD] in the southeastern USA;" therefore, Sandhill oak is at particular risk should the pathogen spread throughout the Southeast.[11]

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:	5
Number of plants in *ex situ* collections:	14
Average number of plants per institution:	3
Percent of *ex situ* plants of wild origin:	79%
Percent of wild origin plants with known locality:	100%

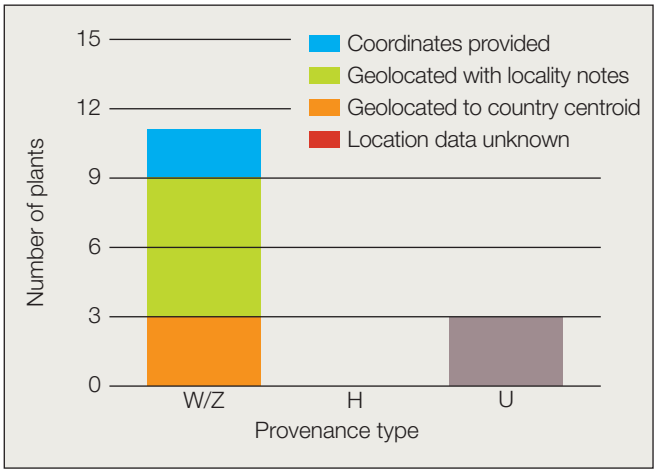

Figure 3. Number and origin of *Quercus inopina* plants in *ex situ* collections. Provenance types: W = wild; Z = indirect wild; H = horticultural; U = unknown.

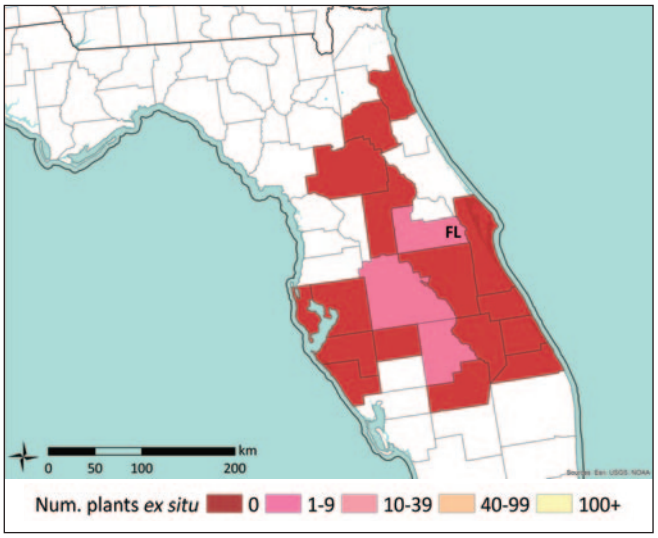

Figure 4. *Quercus inopina* counties of *in situ* occurrence, reflecting the number of plants from each county in *ex situ* collections.

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:	36%
Ecological coverage:	50%

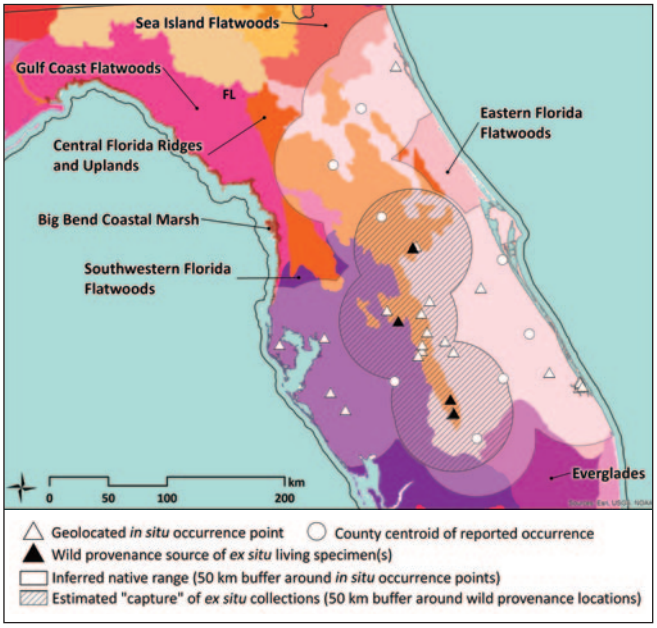

Figure 5. *Quercus inopina in situ* occurrence points and *ex situ* collection source localities. U.S. EPA Level III Ecoregions are colored and labelled.[13] County centroid is shown if no precise locality data exist for that county of occurrence. Email treeconservation@mortonarb.org for information regarding specific coordinates.

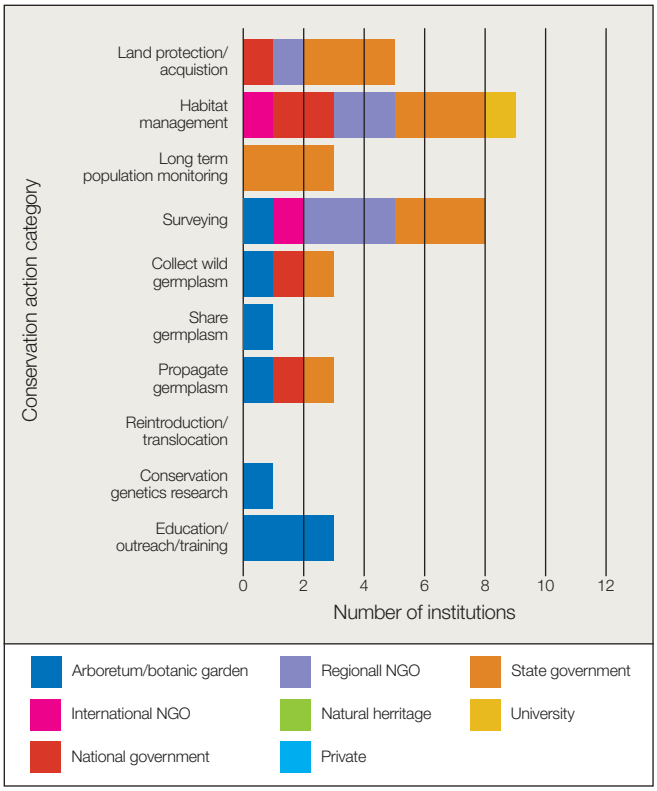

Figure 6. Number of institutions reporting conservation activities for *Quercus inopina* grouped by organization type. Fourteen of 252 institutions reported activities focused on *Q. inopina* (see Appendix D for a list of all responding institutions).

Land protection: Within the inferred native range of *Q. inopina*, 25% of the land is covered by protected areas (Figure 7). In 2010 Moekstra *et al*. estimated that about 35% of the upland ridge and scrub communities of central Florida are formally protected. Ocala National Forest and Archbold Biological Station protect significant blocks of upland scrub habitat, including important *Q. inopina* populations.[14]

Lake Wales Ridge is the oldest of the beach and sand dune systems under protection and extends south from Orange County to Highlands County. Housing development and agriculture are the main threat to this habitat. A study of Lake Wales Ridge found that more than 85% of original scrub and other upland habitats on the Ridge are currently developed. Efforts to purchase scrub habitat in this area have been carried out by state and federal governments, in addition to non-profit organizations such as The Nature Conservancy. A network of more than 16,000 acres have been brought into protection since 1980. Lake-June-in-Winter State Park in southern Highlands County is an excellent example of *Q. inopina* original scrub habitat.[7,14] *Quercus inopina* has also been reported within the Savannas Preserve State Park and Tilton conservation area.[15]

Sustainable management of land: Archbold Biological Station burns at an intermediate frequency, about once every five to 20 years.[16] The Sand Lakes Conservation Area (approximately 1300 acres) has dictated the use of fire management, invasive plant removal, and forest management (silviculture) through a management plan.[17] In general, many public and private land managers in Florida practice prescribed burning (M. Jenkins pers. comm., 2017).

Population monitoring and/or occurrence surveys: The Institute for Regional Conservation tracks *Q. inopina* and has determined it to be Critically Imperiled in southern Florida.[15]

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

Propagation and/or breeding programs: Three institutions reported this activity in the conservation action questionnaire, but no other details are currently known.

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

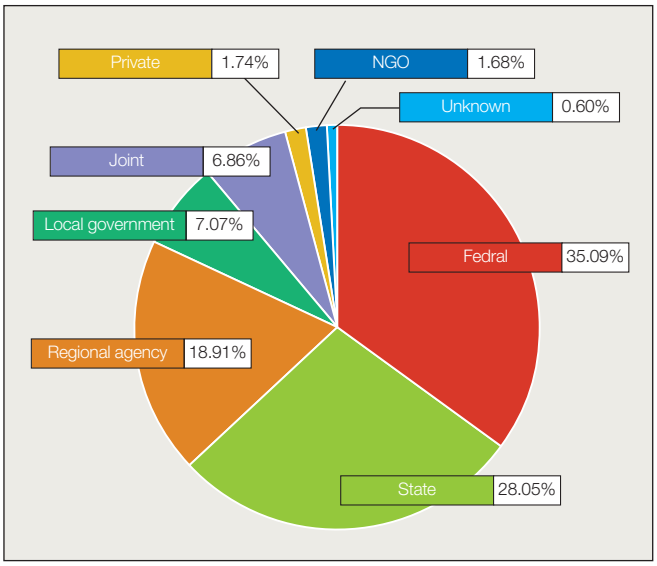

Figure 7. Management type of protected areas within the inferred native range of *Quercus inopina*. Protected areas data from the U.S. Geological Survey Gap Analysis Program (GAP) 2016 Protected Areas Database of the U.S. (PAD-US).[5]

Research: A study of acorn production in south-central Florida found that the smallest individuals (0.3–0.8 meters) of *Q. inopina* produced very few acorns (<5%), with each individual never generating more than five acorns.[18] The optimal fire return interval has also been studied for scrub habitat housing Sandhill oak. A general value could not be determined, but rather a variable prescribed fire interval was recommended due to "the high degree of variation in scrub types and site conditions, including an individual site's burn history. For example, fire return intervals between 8 and 15 years have been recommended as optimal for maintaining Florida scrub-jay populations in *Quercus inopina*-dominated scrub."[19]

Education, outreach, and/or training: Three 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.

PRIORITY CONSERVATION ACTIONS

Proper land management is critical for Sandhill oak to prosper, including prescribed fire as dictated by site conditions, and further rehabilitation of once-suitable habitat contiguous with remaining fragmented preserved and/or maintained habitats. This restoration could include reintroduction and/or reinforcement where populations are small or fragmented. Emphasis should also be placed on *ex situ* conservation of germplasm from throughout the species' range, especially from isolated populations or those persisting on poorly managed land or private lands with uncertain future. Further land protection could be carried out where possible, but it is likely that education and training of land managers and/or owners, both public and private, will be the most effective solution. Populations should continue to be monitored for health and losses to land development. Research regarding appropriate land management techniques including fire and other replications of natural disturbance regimes should be furthered, to better understand best management practices.

Conservation recommendations for *Quercus inopina*

Highest Priority

- Sustainable management of land

Wild collecting and/or *ex situ* curation

Recommended

- Education, outreach, and/or training
- Land protection
- Population monitoring and/or occurrence surveys
- Reintroduction, reinforcement, and/or translocation
- Research (climate change modeling; demographic studies/ecological niche modeling; land management/disturbance regime needs; pests/pathogens; population genetics)


Ron Lance

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