Quercus imbricaria

Shingle Oak

Fagaceae

Quercus imbricaria courtesy Julie Makin, Lady Bird Johnson Wildflower Center

***Quercus imbricaria* Rare Plant Profile**

New Jersey Department of Environmental Protection
State Parks, Forests & Historic Sites
Forests & Natural Lands
Office of Natural Lands Management
New Jersey Natural Heritage Program

501 E. State St.
PO Box 420
Trenton, NJ 08625-0420

Prepared by:
Jill S. Dodds
jsdodds@biostarassociates.com

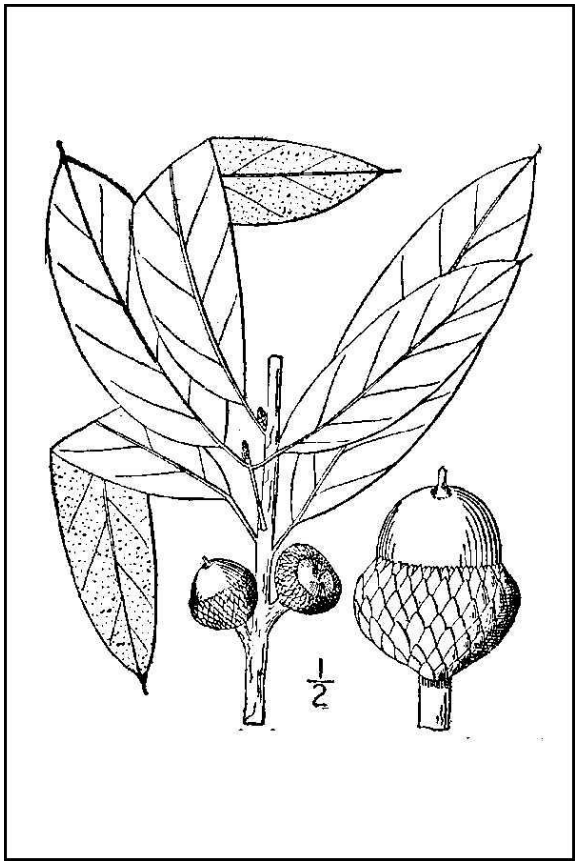
September, 2024

For:
New Jersey Department of Environmental Protection
Office of Natural Lands Management
New Jersey Natural Heritage Program
natlands@dep.nj.gov

This report should be cited as follows: Dodds, Jill S. 2024. *Quercus imbricaria* Rare Plant Profile. New Jersey Department of Environmental Protection, State Parks, Forests & Historic Sites, Forests & Natural Lands, Office of Natural Lands Management, New Jersey Natural Heritage Program, Trenton, NJ. 19 pp.

Life History

Quercus imbricaria (Shingle Oak) is a deciduous tree in *Quercus* Section *Lobatae*, which is informally referred to as the red oak group. Mature *Q. imbricaria* trees are usually under 20 meters in height with a trunk diameter of 15–50 cm, although some individuals are taller (up to 32 m) and have trunk diameters close to a meter. Shingle Oaks generally have a distinct central axis but trees growing from stump sprouts or in disturbed habitats can exhibit irregular branching or even develop a bushy aspect. The gray-brown bark is flat with shallow fissures and ridges. *Q. imbricaria* leaves are elliptical, smooth-edged, and bristle-tipped—they are shiny dark green above and evenly hairy on the underside. It takes at least 25 years for a Shingle Oak tree to reach reproductive maturity (Schopmeyer 1974). Oaks have unisexual inflorescences: The staminate catkins are many-flowered and pendulous while the pistillate are few-flowered and sessile. The single-seeded fruits of *Q. imbricaria* (acorns) take two years to develop. They are typically solitary or in pairs on short peduncles. The acorns are ovoid or round and about 10–18 mm in diameter, with a scaly basal cup that covers ⅓ to ½ of the nut. (See Britton and Brown 1913, Fernald 1950, Wagner and Schoen 1976, Gleason and Cronquist 1991, Stein et al. 2001, Jensen 2020).



Left: Britton and Brown 1913, courtesy USDA NRCS 2024a. Right: Courtesy Julie Makin, Lady Bird Johnson Wildflower Center.

Quercus imbricaria blooms in late April or May, concurrent with leaf expansion, and the acorns are mature in October of the second year (Hough 1983, Migaskó and Ecseri 2020, Weakley et al.

2024). By mid-November the leaves turn light brown and they remain on the trees throughout the winter and sometimes into early spring, making the trees easy to detect from a distance (Wagner and Schoen 1976). The terminal buds are 3–6 mm long, ovoid in outline, five-angled in cross-section, brown or red-brown, and somewhat silky. Short hairs are present along the edges of the bud scales (Trelease 1931, Petrides 1988, Jensen 2020).

Left: Courtesy Julie Makin, Lady Bird Johnson Wildflower Center. Right: Steve Hurst, courtesy USDA NRCS 2024b.

The lobeless leaves of *Quercus imbricaria* make it relatively easy to distinguish from most other oak species that occur in New Jersey. *Q. phellos* also has smooth-edged leaves but they are more linear in shape and are not uniformly hairy on the lower surface. The leaves of *Q. laurifolia*, which is reportedly adventive in the state, are smooth on the underside. However, the oaks hybridize readily and that can complicate identification. *Quercus imbricaria* is known to hybridize with nine other species (Jensen 2020), eight of which occur in New Jersey. Hybrids resulting from crosses between *Q. phellos* and several other species may also closely resemble *Q. imbricaria* (Small 1942, Snyder 1994). Wagner and Schoen (1976) observed that *Q. imbricaria* hybrids often have asymmetrical leaves or venation, and Snyder (1994) noted that hybrids involving *Q. phellos* are usually not hairy on their lower leaf surfaces.

Pollinator Dynamics

Quercus species are pollinated by wind and their staminate inflorescences produce copious amounts of pollen. The apetalous flowers and the release of pollen while the leaves are still expanding increase the probability of successful fertilization. Despite the high frequency of hybridization within the genus many species are thought to be partially or entirely self-sterile, although not all of them have been studied. When oaks in Subgenus Lobatae are pollinated a pollen tube is initiated immediately but fertilization and development are typically deferred until the following spring (Elias 1971). According to Schopmeyer (1974), mature *Quercus imbricaria* trees generally produce a crop of acorns every 2–4 years.

Seed Dispersal and Establishment


J. S. Dodds, 2014

The Blue Jay (*Cyanocitta cristata*) is thought to play a critical role in the dispersal of *Quercus imbricaria* acorns (Harrison and Werner 1984, Aizen and Patterson 1990, Bretthauer et al. 2007). Blue Jays eat both seeds and insects but during the fall they focus on mast-fruiting trees in the Fagaceae, consuming some of the fruits and caching others. The harmful effects of tannins in the acorns appear to be offset by the simultaneous consumption of larval weevils or other insects that feed on the nuts, serving as an incentive for the jays to preferentially eat the wormy acorns and cache the ones that are not infested (Johnson et al. 1993). The birds have expandable throats that allows them to carry multiple acorns in a single trip. Seeds are often cached 50–500 meters from the source trees but they can sometimes be transported for several kilometers. Cache sites may include hollow trees or old bird nests but the Blue Jays often place individual nuts on the ground and cover them with leaves, facilitating germination. Most ground caching takes place in open woodlands and canopy gaps or along forest edges (Graber et al. 1987, Johnson and Webb 1989, Johnson et al. 1997). Both direct observations and preference studies indicate that Blue Jays favor small to medium acorns when there is a choice, although they will utilize large acorns when smaller ones are not available (Johnson and Webb 1989, Johnson et al. 1997, Moore and Swihart 2006). Data provided by Aizen and Patterson (1990) shows that the acorns of *Q. imbricaria* are medium-sized when compared to other North American oaks: They are slightly larger in size than those of *Q. palustris*—the species preferred by jays in Moore and Swihart's selection study—and half the size of *Q. velutina* acorns, which were utilized at an intermediate level. Although *Q. imbricaria* was not included in Moore and Swihart's preference experiments, Graber et al. (1987) observed that Shingle Oak acorns were often the first choice of fall-foraging Blue Jays in Illinois.

The acorns of most species in Section Lobatae experience an interval of dormancy prior to germination (Elias 1971) and those of *Quercus imbricaria* require a 1–2 month period of cold stratification (Leopold 2005). Oak seeds have a high moisture content and they are sensitive to desiccation so they do not remain viable for long: Consequently *Q. imbricaria* acorns either germinate the first spring after dispersal or they fail to do so at all (Schopmeyer 1974, Wyse and Dickie 2017). *Quercus* species form fungal associations that are usually ectomycorrhizal, meaning that they are external to the plants' roots (Wang and Qiu 2006). However some *Q. imbricaria* seedlings examined by Rothwell et al. (1983) had a dual mycorrhizal condition—the expected ectomycorrhizae were present but endomycorrhizae were also observed inside the root cortex. It is not clear whether that is typical of Shingle Oak or if the investigators recorded an exceptional occurrence.

Habitat

Quercus imbricaria is usually found at elevations between 100–700 meters above sea level, although it occasionally occurs at elevations up to 1500 meters. Typical habitat is dry to moist woodlands, and the trees can tolerate a broad range of light conditions from full sun to dense shade (Bazzaz and Carlson 1982, Leopold 2005, Rhoads and Block 2007, Jensen 2020, Weakley et al. 2024). Occurrences at lower elevations are generally situated in places that rarely flood (Bell 1973, Bretthauer et al. 2007). Shingle Oaks exhibit high water use efficiency, adjusting to drought conditions by slowing growth or reducing the frequency of foliage replacement (McCarthy and Dawson 1990, 1991). *Q. imbricaria* has demonstrated an adaptability to manmade habitats, sometimes becoming abundant along roadsides or hedgerows (Wagner and Schoen 1976, Stoynoff and Hess 2002). The New Jersey population is situated on and adjacent to a railroad embankment (NJNHP 2024).

Quercus imbricaria often grows as a single tree or in small clusters of individuals (Wagner and Schoen 1976) but in some settings it is a dominant canopy species (Bell 1974, Monk et al. 1989, Bretthauer et al. 2007). It is generally more abundant in early or mid-successional sites, and low replacement rates have been reported in mature stands (Gleason 1912, Bell 1974, Brenner 1952, McBride 1973, Larimore et al. 2008, Eilers 2011). *Q. imbricaria* seedlings can become established in shaded sites, although their growth is likely to be slower (McCarthy and Dawson 1990, Zaczek et al. 1999 & 2000). The higher frequency of young *Q. imbricaria* trees in more open habitats is probably attributable to the caching behavior of Blue Jays (Bretthauer et al. 2007).

Wetland Indicator Status

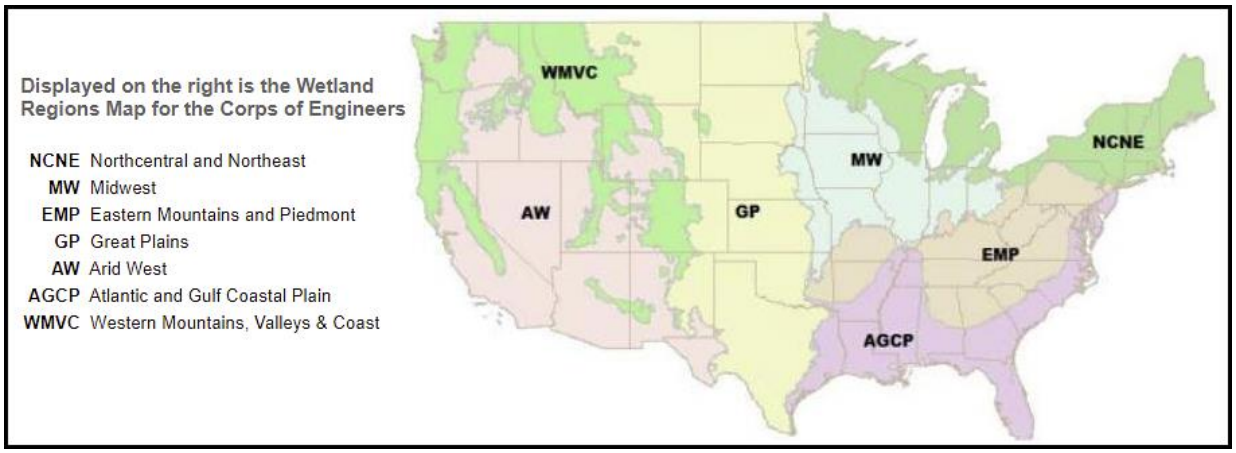


Figure 1. Mainland U. S. wetland regions, adapted from U. S. Army Corps of Engineers (2020).

The U. S. Army Corps of Engineers divided the country into a number of regions for use with the National Wetlands Plant List and portions of New Jersey fall into three different regions (Figure 1). *Quercus imbricaria* has more than one wetland indicator status within the state. In the Northcentral and Northeast region, *Q. imbricaria* is a facultative upland species, meaning that it usually occurs in nonwetlands but may occur in wetlands. In the rest of the state it is a

facultative species, meaning that it is equally likely to occur in wetlands or nonwetlands (U. S. Army Corps of Engineers 2020).

USDA Plants Code (USDA, NRCS 2024c)

QUIM

Coefficient of Conservancy (Walz et al. 2020)

CoC = 8. Criteria for a value of 6 to 8: Native with a narrow range of ecological tolerances and typically associated with a stable community (Faber-Langendoen 2018).

Distribution and Range

The global range of *Quercus imbricaria* is restricted to the central and eastern United States (POWO 2024). The map in Figure 2 depicts the extent of Shingle Oak in North America.

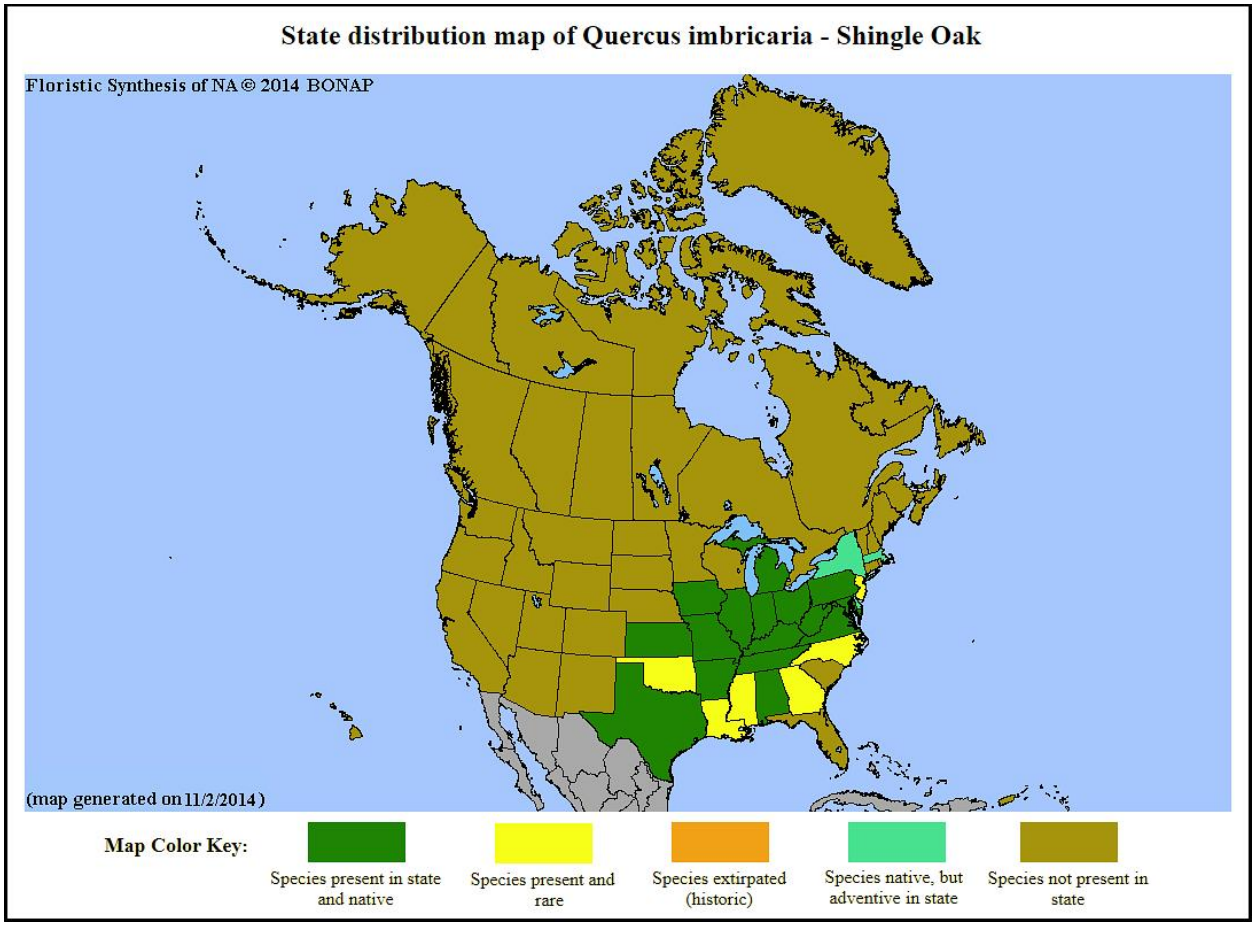


Figure 2. Distribution of Q. imbricaria in North America, adapted from BONAP (Kartesz 2015).

The USDA PLANTS Database (2024c) shows records of *Quercus imbricaria* in six New Jersey counties: Burlington, Cape May, Cumberland, Gloucester, Mercer, and Middlesex (Figure 3). The species has also been reported in Camden, Monmouth, and Salem counties (Mid-Atlantic Herbaria 2024). The data include historic records and do not reflect the current distribution of the species.

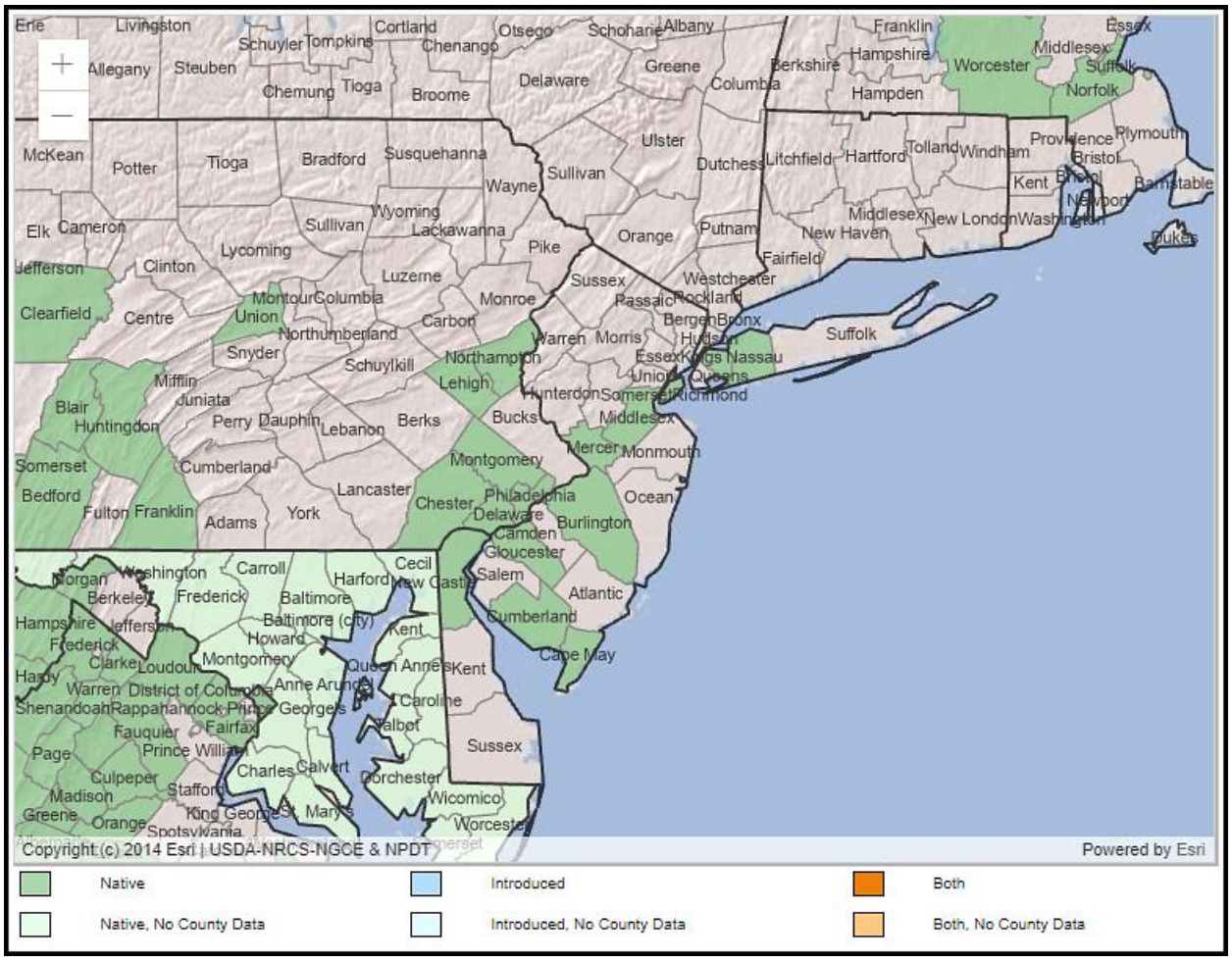


Figure 3. County records of Q. imbricaria in New Jersey and vicinity (USDA NRCS 2024c).

Conservation Status

Quercus imbricaria is considered globally secure. The G5 rank means the species has a very low risk of extinction or collapse due to a very extensive range, abundant populations or occurrences, and little to no concern from declines or threats (NatureServe 2024). The map below (Figure 4) illustrates the conservation status of *Q. imbricaria* throughout its range. Shingle Oak is vulnerable (moderate risk of extinction) in one state, imperiled (high risk of extinction) in two states and the District of Columbia, and critically imperiled (very high risk of extinction) in three states. In most of the states where it occurs *Q. imbricaria* is secure, apparently secure, or unranked. Occurrences in Delaware and New York are not accepted as native.

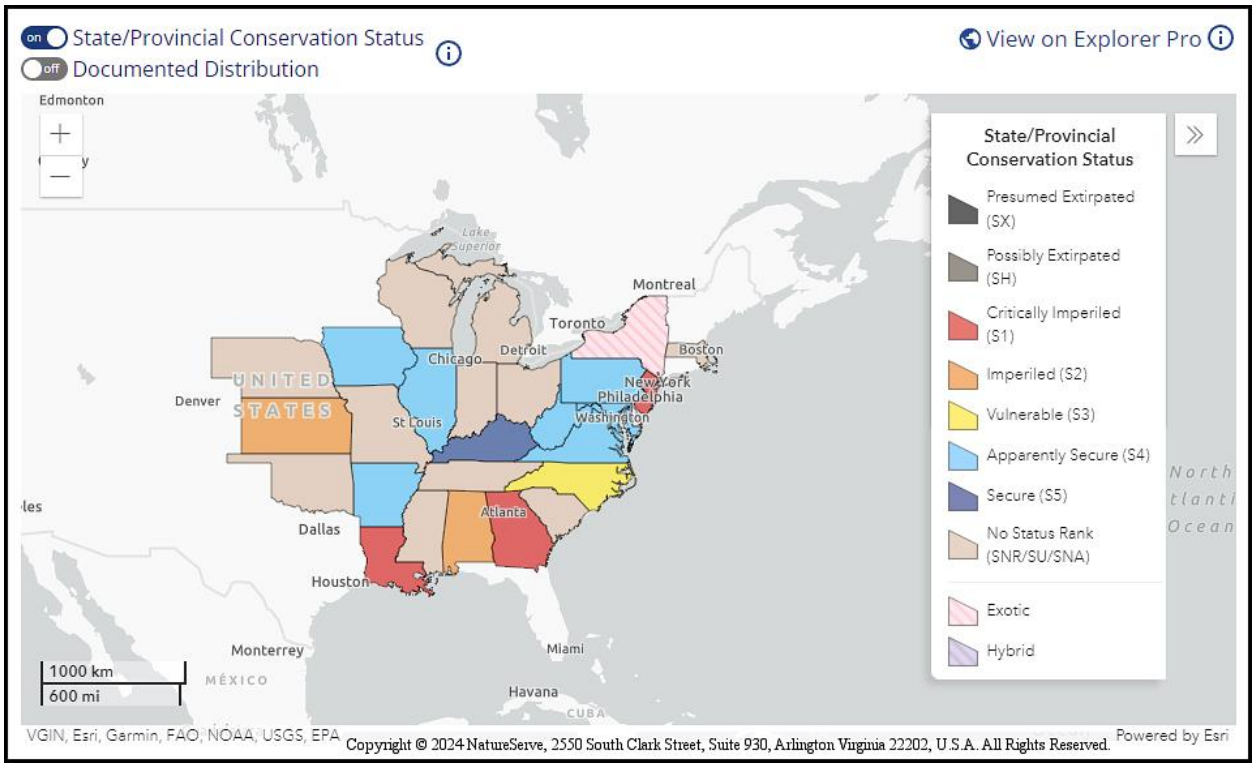


Figure 4. Conservation status of Q. imbricaria in North America (NatureServe 2024).

Quercus imbricaria is ranked S1.1 in New Jersey (NJNHP 2024), meaning that it is critically imperiled due to extreme rarity. The S1.1 rank indicates that there is adequate documentation of the species for only one location. *Q. imbricaria* is also listed as an endangered species (E) in New Jersey, meaning that without intervention it has a high likelihood of extinction in the state. Although the presence of endangered flora may restrict development in certain communities such as wetlands or coastal habitats, being listed does not currently provide broad statewide protection for the plants. Additional regional status codes assigned to *Q. imbricaria* signify that the tree is eligible for protection under the jurisdictions of the Highlands Preservation Area (HL) and the New Jersey Pinelands (LP) (NJNHP 2010).

Despite historic reports of *Quercus imbricaria* in nearly half of New Jersey's counties only one population is believed to be a native occurrence of the species. *Q. imbricaria* was not included in any of the early state floras, although Stone (1911) mentioned it as a possible 'parent' species of some hybrid oaks in southern New Jersey. Certain trees that were initially identified as *Q. imbricaria* quickly came into question: Small (1942) noted that a protracted discussion about a Burlington County tree had taken place during a botanical club field trip and Snyder (1994) remarked that debate about a Cape May population went on for several decades before it was resolved as a hybrid occurrence. Fairbrothers and Hough (1973) accepted a number of records that have since been rejected but still classified *Q. imbricaria* as an endangered species due to its rarity in the state. Most New Jersey reports of Shingle Oak turned out to be based on cultivated trees, hybrids, or misidentified specimens (Snyder 1994). The sole accepted occurrence was first documented in 1904 and the population was relocated in 1989, at which time it consisted of about 20 trees (Snyder 1994, 2000). Only a single *Q. imbricaria* tree has been observed at the site in recent years (NJNHP 2024).

Threats

Fairbrothers and Hough (1973) indicated that the conversion of land for housing and agriculture was a threat to New Jersey populations of *Quercus imbricaria*, although some of the occurrences they had in mind were probably stands of hybrid oaks. The single population now believed to be a native occurrence has been reduced in size by maintenance activities associated with a railway corridor (NJNHP 2024).

Fire can have a detrimental effect on *Quercus imbricaria*, and particularly on young trees. A thick layer of bark may help to protect mature trees from fire damage, but Hengst and Dawson (1993) reported that the bark of *Q. imbricaria* was relatively thin in comparison to other oaks. Following a spring burn in an Indiana woodland 40% of the established *Q. imbricaria* trees survived the fire, 30% subsequently reestablished from basal sprouts, and 30% did not recover; while all of the seedlings were destroyed (Dolan 1994). Shingle Oak saplings do not exhibit fire resistance until they reach about 3 meters in height (Hruska and Ebinger 1995). At one Illinois site, Taft (2005) indicated that 85% of *Quercus imbricaria* saplings had been eliminated by a prescribed burn. Taft (2003) recorded an increase in the presence of *Q. imbricaria* seedlings at another site that had been burned during 1989 and 1994, but the seeds were probably introduced after the fires. Johnson et al. (1997) noted that although Blue Jays do not often utilize open grasslands as caching sites the birds were more likely to cache acorns in grasslands that had recently burned.

Quercus imbricaria trees have occasionally been found hosting Eastern Mistletoe, *Phoradendron leucarpum* (Thompson et al. 2008, Overlease and Overlease 2011). Mistletoes are hemiparasitic plants that are heavily reliant on their hosts for water and nutrients. Water demands placed on mistletoe hosts may disrupt normal stomatal operation and reduce photosynthetic activity. The impact can vary widely depending on the initial vigor of the host tree and the extent of the parasite load (Glatzel and Geils 2009).

Insects utilize oak trees in a variety of ways with consequences that range from negligible to devastating. For example, an oak gallwasp (*Zapatella quercusphellos*) induces stem-swelling galls on *Q. imbricaria* (Pujade-Villar et al. 2012). Some stem damage may also result from egg-laying cicadas, as the tips of the branches beyond the oviposition sites usually die off. However, periodical cicadas studied by Clay et al. (2009) exhibited no particular preference for *Q. imbricaria* and cicada oviposition does not typically cause long term damage to mature trees (Kratzer 2024). In contrast, the larvae of slug moths (Limacodidae) showed an unusual penchant for *Quercus imbricaria*—The caterpillars generally favor leaves with smooth lower surfaces so their abundance on the hairy leaves of Shingle Oak was an unexpected result during a study of their feeding preferences (Lill et al. 2006). Nevertheless, the small larvae are not likely to have any noticeable effect on a grown oak tree. The New Jersey Forest Service has identified two insects as a particular threat to *Quercus* species: The Oak Shothole Leafminer (*Japanagromyza viridula*) and the Spongy Moth (*Lymantria dispar*). The Oak Shothole Leafminer is a native fly that is becoming increasingly common in the state. Female flies puncture young oak leaves to feed on their fluids and the holes become enlarged as the leaves expand, resembling Swiss cheese. *Lymantria dispar* is an introduced species that has been present in New Jersey for over a century. The larvae can feed on a wide variety of trees but have a strong preference for oaks,

and host plants can be completely defoliated when moth populations are near the high end of their natural 'boom and bust' cycle (NJFS 2022).

A number of diseases can also threaten *Quercus* populations. Oak Wilt Disease (*Bretziella fagacearum*) is prevalent in the red oak group and is probably the most serious. Elias (1971) noted the rapid spread of the pathogen from the midwest into the eastern and southern states. As of two years ago, the presence of *B. fagacearum* had not been confirmed in New Jersey although it had been documented in adjacent states. The disease typically develops in the uppermost branches and spreads downward, and infected trees may be dead within months or even weeks (Elias 1971, NJFS 2022). Bacterial Leaf Scorch (*Xylella fastidiosa*) can also be fatal, although affected trees decline more slowly, sometimes persisting for a decade after the initial infection. If *X. fastidiosa* is detected early it may be manageable but annual treatments are required (NJFS 2008). *Phytophthora* species are pathogens that cause stem lesions and crown or root rot in woody plants. Experimental inoculation of intact and wounded leaves with *Phytophthora* spp. showed that many eastern trees are also susceptible to foliar infections. No lesions were formed on mature leaves of *Quercus imbricaria* whether the foliage was injured or not, and young leaves were generally only slightly susceptible even when wounded (Balci et al. 2008). It is not clear whether Shingle Oak's apparent resistance to *Phytophthora* extends to woody parts of the plant.

Climate Change Vulnerability

Information from the references cited in this profile was used to evaluate the vulnerability of New Jersey's *Quercus imbricaria* population to climate change. The species was assigned a rank from NatureServe's Climate Change Vulnerability Index using the associated tool (Version 3.02) to estimate its exposure, sensitivity, and adaptive capacity to changing climactic conditions in accordance with the guidelines described by Young et al. (2016) and the state climactic computations by Ring et al. (2013). Based on available data *Q. imbricaria* was assessed as Less Vulnerable, meaning that climate change is not expected to have a notable detrimental impact on its extent in New Jersey by 2050. However, the conclusion was reached with a low level of confidence because the score placed it right on the cusp of moderate vulnerability.

Shifting climactic conditions in New Jersey are resulting in higher temperatures, more frequent and intense precipitation events, and increasing periods of drought (Hill et al. 2020). *Quercus imbricaria* is at the northeastern end of its range in New Jersey, so it is likely able to tolerate warmer temperatures. Although McCarthy and Dawson (1990, 1991) characterized *Q. imbricata* as a relatively drought tolerant species their experimentally imposed drought only lasted for two months and even then some effects on growth and vigor were noted. *Q. imbricaria* acorns are also sensitive to desiccation so the timing and extent of a drought could affect the seeds' ability to germinate (Wyse and Dickie 2017). It is not clear whether or how climate change will influence the spread of oak pathogens in the mid-Atlantic region.

An evaluation in Illinois predicted that *Quercus imbricaria* would cope with climate change poorly or very poorly, particularly under a high emissions scenario. A low emissions scenario might actually permit the species to expand its distribution in certain parts of the eastern United States, though the outcome is likely to depend on regeneration capacity (Iverson et al. 2005 &

2017, Iverson and Taft 2022). There appears to be some potential for *Q. imbricaria* to extend its range northward as the climate continues to change. Shingle Oak can reportedly tolerate winter temperatures between -20 and -40°C (Ballesteros and Pritchard 2020). Johnson and Webb (1989) suggested that transport by Blue Jays could facilitate climate-driven range shifts for species in the Fagaceae, and there is evidence that the jays are already expanding their range in a northerly direction (National Audubon Society 2024).

Management Summary and Recommendations

It is not surprising that a significant proportion of conservation resources have traditionally been allocated to plant species with high economic value, and trees often fall into that category. *Quercus imbricaria* was historically used to make shingles because the wood was easy to split, although the timber is of lesser commercial importance today (ISUE 2024). The oaks have received a lot of attention around alternatives for storage and propagation because their acorns do not remain viable for long. Schopmeyer (1974) found that the life of oak seeds could be extended if they were sealed in polyethylene bags and stored at a temperature just above freezing (4° C). Recent work on *Q. imbricaria* has tested various approaches for cryopreservation of embryonic material and explored techniques for micropropagation using the tissue of dormant buds (Faria et al. 2019, Ballesteros and Pritchard 2020). *Quercus imbricaria* appears to be secure throughout much of its range so there is no urgent necessity for offsite propagation and reintroduction at this time.

New Jersey's *Quercus imbricaria* population is in need of a comprehensive assessment. The single tree observed during the last monitoring visit had several large, dead limbs near the top. However, there could be additional Shingle Oak trees in the adjacent woodland (NJNHP 2024). A thorough search of suitable habitat in the vicinity is recommended. It would be beneficial to monitor changes in the health of the most prominent tree and, if possible, determine the cause of the previously observed limb mortality. Surveyors should also attempt to ascertain whether acorns are being produced in order to evaluate the species' potential for regeneration in that location.

Synonyms

The accepted botanical name of the species is *Quercus imbricaria* Michx. Orthographic variants, synonyms, and common names are listed below (ITIS 2024, POWO 2024, USDA NRCS 2024c).

Botanical Synonyms	Common Names
Quercus phellos var. *imbricaria* (Michx.) Spach	Shingle Oak
Quercus aprica Raf.	
Quercus imbricaria var. *inaequalifolia* Kuntze	
Quercus imbricaria var. *spinulosa* A.DC.	
Quercus latifolia Steud.	

Quercus sonchifolia Booth ex G. Kirchn.
Erythrobalanus imbricaria (Michx.) O. Schw

References

Aizen, Marcelo A. and William A. Patterson. 1990. Acorn size and geographical range in the North American oaks (*Quercus* L.). Journal of Biogeography 17: 327–332.

Balci, Y., S. Balci, W. L. MacDonald, and K. W. Gottschalk. 2008. Foliar susceptibility of eastern oak species to *Phytophthora* infection. Forest Pathology 38: 320–331.

Ballesteros, D. and H. W. Pritchard. 2020. The cryobiotechnology of oaks: An integration of approaches for the long-term ex situ conservation of *Quercus* species. Forests11(12): Article 1281.

Bazzaz, F. A. and Roger W. Carlson. 1982. Photosynthetic acclimation to variability in the light environment of early and late successional plants. Oecologia 54(3): 313–316.

Bell, David T. 1974. Tree stratum composition and distribution in the streamside forest. The American Midland Naturalist 92(1): 35–46.

Brenner, Louis G. Jr. 1952. Forest quadrat studies at the Arboretum and observations on forest succession. Annals of the Missouri Botanical Garden 39(2): 165–172.

Bretthauer, Scott M., George Z. Gertner, Gary L. Rolfe, and Jeffrey O. Dawson. 2007. Tree species diversity and composition in relation to forest borders in two old-field successional stands at Allerton Park, Piatt County, Illinois USA. Transactions of the Illinois State Academy of Science 100(1): 31–46.

Britton, N. L. and A. Brown. 1913. An Illustrated Flora of the Northern United States and Canada in three volumes: Volume I (Ferns to Buckwheat). Second Edition. Reissued (unabridged and unaltered) in 1970 by Dover Publications, New York, NY. 680 pp.

Clay, Keith, Angela L. Shelton, and Chunk Winkle. 2009. Differential susceptibility of tree species to oviposition by periodical cicadas. Ecological Entomology 34: 277–286.

Dolan, Rebecca W. 1994. Effects of a prescribed burn on tree- and herb-layer vegetation in a Post Oak (*Quercus stellata*) dominated flatwoods. Proceedings of the Indiana Academy of Science 103(1–2): 25–32.

Eilers, Henry. 2011. Managing change in an Illinois oak woodland. International Oak Journal 22: 27–47.

Elias, Thomas S. 1971. The genera of Fagaceae in the southeastern United States. Journal of the Arnold Arboretum 52(1): 159–195.

Faber-Langendoen, D. 2018. Northeast Regional Floristic Quality Assessment Tools for Wetland Assessments. NatureServe, Arlington, VA. 52 pp.

Fairbrothers, David E. and Mary Y. Hough. 1973. Rare or Endangered Vascular Plants of New Jersey. Science Notes No. 14, New Jersey State Museum, Trenton, NJ. 53 pp.

Faria, Jose, Lisa Hill, and Christina Walters. 2019. Strategies to cryopreserve embryonic axes of North American oaks: Interactions of moisture, cryoprotectants and LN exposure rates in *Quercus imbricaria*. Cryobiology 91: 179.

Fernald, M. L. 1950. Gray's Manual of Botany. Dioscorides Press, Portland, OR. 1632 pp.

Glatzel, G. and B. W. Geils. 2009. Mistletoe ecophysiology: Host–parasite interactions. Botany 87: 10–15.

Gleason, Henry Allan. 1912. An isolated prairie grove and its phytogeographical significance. Botanical Gazette 53: 38–49.

Gleason, H. A. and A. Cronquist. 1991. Manual of Vascular Plants of Northeastern United States and Adjacent Canada. Second Edition. The New York Botanical Garden, Bronx, NY. 910 pp.

Graber, Jean W., Richard R. Graber, and Ethelyn L. Kirk. 1987. Illinois Birds: Corvidae. Biological Notes 126: 2–42.

Harrison, J. S. and P. A. Werner. 1984. Colonization by oak seedlings into a heterogeneous successional habitat. Canadian Journal of Botany 62: 559-563.

Hengst, Gretel E. and Jeffrey O. Dawson. 1993. Bark thermal properties of selected central hardwood species. In Andrew R. Gillespie, George R. Parker, Phillip E. Pope, and George Rink (eds.)., Proceedings, 9th Central Hardwood Forest Conference, West Lafayette, IN.

Hill, Rebecca, Megan M. Rutkowski, Lori A. Lester, Heather Genievich, and Nicholas A. Procopio (eds.). 2020. New Jersey Scientific Report on Climate Change, Version 1.0. New Jersey Department of Environmental Protection, Trenton, NJ. 184 pp.

Hough, Mary Y. 1983. New Jersey Wild Plants. Harmony Press, Harmony, NJ. 414 pp.

Hruska, Mary C. and John E. Ebinger. 1995. Monitoring a savanna restoration in east-central Illinois. Transactions of the Illinois State Academy of Science 88(3&4): 109–117.

ISUE (Iowa State University Extension and Outreach). 2024. Natural Resource Stewardship: Shingle Oak. Accessed September 4, 2024 at https://naturalresources.extension.iastate.edu/forestry/iowa_trees/trees/shingle_oak.html

ITIS (Integrated Taxonomic Information System). Accessed August 28, 2024 at http://www.itis.gov

Iverson, Louis R. and John B. Taft. 2022. Past, present, and possible future trends with climate change in Illinois forests. Erigenia 28: 53–70.

Iverson, Louis R., Anantha M. Prasad, and Mark W. Schwartz. 2005. Predicting potential changes in suitable habitat and distribution by 2100 for tree species in the eastern United States. Journal of Agricultural Meteorology 61(1): 29–37.

Iverson, Louis R., Matthew P. Peters, Stephen N. Matthews, Anantha Prasad, Todd Hutchinson, Jarel Bartig, Joanne Rebbeck, Dan Yaussy, Susan Stout, and Greg Nowacki. 2017. Adapting oak management in an age of ongoing mesophication but warming climate. In Stacy L. Clark and Callie J. Schweitzer (eds)., Oak Symposium: Sustaining Oak Forests in the 21st Century through Science-based Management, Knoxville, TN.

Kratzer, Chris Alice. 2024. The Cicadas of North America. Owlfly Publishing, Frenchtown, NJ. 573 pp.

Jensen, Richard J. Page updated November 5, 2020. *Quercus imbricaria* Michaux. In: Flora of North America Editorial Committee, eds. 1993+. Flora of North America North of Mexico [Online]. 22+ vols. New York and Oxford. Accessed August 28, 2024 at http://floranorthamerica.org/Quercus_imbricaria

Johnson, W. C. and T. Webb, III. 1989. The role of Blue Jays (*Cyanocitta cristata* L.) in the postglacial dispersal of Fagaceous trees in eastern North America. Journal of Biogeography 16(6): 561–571.

Johnson, W. C., L. Thomas, and C. S. Adkisson. 1993. Dietary circumvention of acorn tannins by Blue Jays. Implications for oak demography. Oecologia 94(2): 159–164.

Johnson, W. C., C. S. Adkisson, T. R. Crow, and M. D. Dixon. 1997. Nut caching by Blue Jays (*Cyanocitta cristata* L.): Implications for tree demography. American Midland Naturalist 138(2): 357–370.

Kartesz, J. T. 2015. The Biota of North America Program (BONAP). Taxonomic Data Center. (http://www.bonap.net/tdc). Chapel Hill, NC. [Maps generated from Kartesz, J. T. 2015. Floristic Synthesis of North America, Version 1.0. Biota of North America Program (BONAP) (in press)].

Larimore, Richard L., Loy R. Phillippe, and John E. Ebinger. 2008. Vascular flora of Middle Fork Woods Nature Preserve, Vermilion County, Illinois. Illinois Natural History Survey Bulletin 38(4): 177–196.

Leopold, Donald J. 2005. Native Plants of the Northeast: A Guide for Gardening and Conservation. Timber Press, Portland, OR. 308 pp.

Lill, John T., Robert J. Marquis, Rebecca E. Forkner, Josiane Le Corff, Nels Holmberg, and Nicholas A. Barber. 2006. Leaf pubescence affects distribution and abundance of generalist slug caterpillars (Lepidoptera: Limacodidae). Environmental Entomology 35(3): 797–806.

Makin, Julie. 2012. Three photos of *Quercus imbricaria*. Courtesy of the Lady Bird Johnson Wildflower Center, https://www.wildflower.org/. Used with permission.

McBride, Joe. 1973. Natural replacement of disease-killed elms. The American Midland Naturalist 90(2): 300–306.

McCarthy, J. J. and J. O. Dawson. 1990. Growth and water use efficiency of *Quercus alba*, *Q. bicolor*, *Q. imbricaria* and *Q. palustris* seedlings under conditions of reduced soil water availability and solar irradiance. Transactions of the Illinois State Academy of Science 83(3–4): 128–148.

McCarthy, J. J. and J. O. Dawson. 1991. Effects of drought and shade on growth and water use of *Quercus alba*, *Q. bicolor*, *Q. imbricaria* and *Q. palustris* seedlings. In Larry H. McCormick and Kurt W. Gottschalk, (eds.). Proceedings, 8th Central Hardwood Forest Conference; 1991 March 4-6; University Park, PA. General Technical Report NE-148, USDA Forest Service, Northeastern Forest Experiment Station, Radnor, PA.

Mid-Atlantic Herbaria. 2024. Accessed at https://midatlanticherbaria.org/portal/index.php on August 28, 2024.

Migaskó, Helga Sz. and Károly Ecseri. 2020. Phenological differences of *Quercus* taxa. Gradus 7(2): 135–140.

Monk, Carl D., Donald W. Imm, Robert L. Potter, and Geoffrey G. Parker. 1989. A classification of the deciduous forest of eastern North America. Vegetatio 80: 167–181.

Moore, Jeffrey E. and Robert K. Swihart. 2006. Nut selection by captive Blue Jays: Importance of availability and implications for seed dispersal. The Condor 108(2): 377–388.

National Audubon Society. 2024. Blue Jay. Accessed September 4, 2024 at https://www.audubon.org/field-guide/bird/blue-jay

NatureServe. 2024. NatureServe Explorer [web application]. NatureServe, Arlington, VA. Accessed August 28, 2024 at https://explorer.natureserve.org/

NJFS (New Jersey Forest Service). 2022. Forest Health Highlights. Accessed August 28, 2024 at https://www.fs.usda.gov/foresthealth/docs/fhh/NJ_FHH_2022.pdf

NJNHP (New Jersey Natural Heritage Program). 2010. Explanation of Codes Used in Natural Heritage Reports. Updated March 2010. Available at https://nj.gov/dep/parksandforests/natural/docs/nhpcodes_2010.pdf

NJNHP (New Jersey Natural Heritage Program). 2024. Biotics 5 Database. NatureServe, Arlington, VA. Accessed March 15, 2024.

Overlease, William and Edith Overlease. 2011. A note on the host species of Mistletoe (*Phoradendron leucarpum*) in the eastern United States. Bartonia 65: 105–111.

Petrides, George A. 1988. Eastern Trees. Peterson Field Guides, Houghton Mifflin Company, Boston. 272 pp.

POWO. 2024. Plants of the World Online. Facilitated by the Royal Botanic Gardens, Kew. Accessed August 28, 2024 at http://www.plantsoftheworldonline.org/

Pujade-Villar, Juli, Paul Hanson, Claudia A. Medina, Miguel Torres, and George Melika. 2012. A new genus of oak gallwasps, *Zapatella* Pujade-Villar & Melika, gen. n., with a description of two new species from the Neotropics (Hymenoptera, Cynipidae, Cynipini). ZooKeys 210: 75–104.

Rhoads, Ann Fowler and Timothy A. Block. 2007. The Plants of Pennsylvania. University of Pennsylvania Press, Philadelphia, PA. 1042 pp.

Ring, Richard M., Elizabeth A. Spencer, and Kathleen Strakosch Walz. 2013. Vulnerability of 70 Plant Species of Greatest Conservation Need to Climate Change in New Jersey. New York Natural Heritage Program, Albany, NY and New Jersey Natural Heritage Program, Department of Environmental Protection, Office of Natural Lands Management, Trenton, NJ, for NatureServe #DDCF-0F-001a, Arlington, VA. 38 pp.

Rothwell, F. M., E. Hacskaylo, and D. Fisher. 1983. Ecto- and endomycorrhizal fungus associations with *Quercus imbricaria* L. Plant and Soil 71(1/3): 309–312.

Schopmeyer, C. S. (Technical Coordinator). 1974. Seeds of Woody Plants in the United States. Agriculture Handbook No. 450, United States Department of Agriculture, Washington, D. C. 916 pp.

Small, John A. 1942. Field trips of the club. Torreya 42(2): 56–61.

Snyder, David B. 1994. Additions, range extensions, reinstatements, and relocations in the New Jersey flora. Bartonia 58: 79–96.

Snyder, David. 2000. One hundred lost plants found. Bartonia 60: 1–22.

Stein, John, Denise Binion, and Robert Acciavatti. 2001. Field Guide to Native Oak Species in Eastern North America. FHTET-03-01, USDA Forest Service, Forest Health Technology Enterprise Team, Morgantown, WV. 166 pp.

Stone, Witmer. 1911. The Plants of Southern New Jersey. Quarterman Publications, Boston, MA. 828 pp.

Stoynoff, Nick A. and William J. Hess. 2002. The distribution of the genus *Quercus* in Illinois: An update. Transactions of the Illinois State Academy of Science 95(4): 261–284.

Taft, John B. 2003. Fire effects on community structure, composition, and diversity in a dry sandstone barrens. Journal of the Torrey Botanical Society 130(3): 170–192.

Taft, John B. 2005. Fire effects on structure, composition, and diversity in a south-central Illinois flatwoods remnant. Castanea 70(4): 298–313.

Thompson, Ralph L., Katrina Rivers Thompson, Elizabeth A. Fleming, Richard D. Cooks, Jessica R. Price, Megan N. Naseman, and Andrew J. Oles. 2008. Eastern Mistletoe (*Phoradendron leucarpum*, Viscaceae) in the City of Berea, Kentucky: A high incidence of infestation and eight new host species for Kentucky. Journal of the Kentucky Academy of Science 69(1): 2–10.

Trelease, William. 1931. Winter Botany: An Identification Guide to Native Trees and Shrubs. Dover Publications, New York. 396 pp.

U. S. Army Corps of Engineers. 2020. National Wetland Plant List, version 3.5. https://cwbi-app.sec.usace.army.mil/nwpl_static/v34/home/home.html U. S. Army Corps of Engineers Research and Development Center, Cold Regions Research and Engineering Laboratory, Hanover, NH.

USDA, NRCS (U. S. Dept. of Agriculture, Natural Resources Conservation Service). 2024a. *Quercus imbricaria* illustration from Britton, N. L. and A. Brown, 1913, An illustrated flora of the northern United States, Canada and the British Possessions, 3 vols., Kentucky Native Plant Society, New York, Scanned By Omnitek Inc. Image courtesy of The PLANTS Database (http://plants.usda.gov). National Plant Data Team, Greensboro, NC.

USDA, NRCS. 2024b. *Quercus imbricaria* seed photo by Steve Hurst, ARS Systematic Botany and Mycology Laboratory, OH. Image courtesy of The PLANTS Database (http://plants.usda.gov). National Plant Data Team, Greensboro, NC.

USDA, NRCS (U. S. Dept. of Agriculture, Natural Resources Conservation Service). 2024c. PLANTS profile for *Quercus imbricaria* (Shingle Oak). The PLANTS Database, National Plant Data Team, Greensboro, NC. Accessed August 28, 2024 at http://plants.usda.gov

Wagner, W. H., Jr. and D. J. Schoen. 1976. Shingle oak (*Quercus imbricaria*) and its hybrids in Michigan. The Michigan Botanist 15: 141–155.

Walz, Kathleen S., Jason L. Hafstad, Linda Kelly, and Karl Anderson. 2020. Floristic Quality Assessment Index for Vascular Plants of New Jersey: Coefficient of Conservancy (CoC) Values for Species and Genera (update to 2017 list). New Jersey Department of Environmental Protection, New Jersey Forest Service, Office of Natural Lands Management, Trenton, NJ.

Wang, B., and Y. L. Qiu. 2006. Phylogenetic distribution and evolution of mycorrhizas in land plants. Mycorrhiza 16(5): 299–363.

Weakley, A. S. and Southeastern Flora Team. 2024. Flora of the Southeastern United States. Edition of March 4, 2024. University of North Carolina Herbarium, North Carolina Botanical Garden, Chapel Hill, NC. 2023 pp.

Wyse, Sarah V. and John B. Dickie. 2017. Predicting the global incidence of seed desiccation sensitivity. Journal of Ecology 105: 1082–1093.

Young, Bruce E., Elizabeth Byers, Geoff Hammerson, Anne Frances, Leah Oliver, and Amanda Treher. 2016. Guidelines for Using the NatureServe Climate Change Vulnerability Index, Release 3.02, 1 June 2016. NatureServe, Arlington, VA. 65 pp.

Zaczek, J. J., C. W. Heuser, and K. C. Steiner. 1999. Low irradiance during rooting improves propagation of oak and maple taxa. Journal of Environmental Horticulture 17(3): 130–133.

Zaczek, James J., C. W. Heuser Jr., and Kim C. Steiner. 2000. Timing of low solar irradiance affects *Quercus* and *Acer* propagation. Combined Proceedings International Plant Propagators' Society 50: 434–441.