# *Platanthera orbiculata*

**Round-leaf Orchid**

**Orchidaceae**


*Platanthera orbiculata* by Peter M. Dziuk, 2006

***Platanthera orbiculata* Rare Plant Profile**

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

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## Life History

*Platanthera orbiculata* (Round-leaf Orchid) is a perennial orchid with a pair of rounded basal leaves that are glossy-green on top, silvery below, and usually lie flat on the ground. On mature plants the basal leaves are typically 10–15 cm across, although Baldwin (1884) reported that they can often reach widths up to 23 cm. The inflorescence is stiffly erect, 15–60 cm high, and has 1–5 narrow bracts along the stalk below the raceme of 4–31 pale greenish-white flowers. The flowers are held on slender pedicels 6–12 mm long that have linear-lanceolate bracts at their bases. The three sepals are somewhat ovate, with the upper one held erect and the other two spreading. The lateral petals are lance-shaped and often curved, and the lower petal (lip) extends downward in a long, slender spur 14–27 mm long. (See Britton and Brown 1913, Fernald 1950, Brackley 1985, Gleason and Cronquist 1991, Reddoch and Reddoch 1993, Sheviak 2020).

Peter M. Dziuk, 2007.

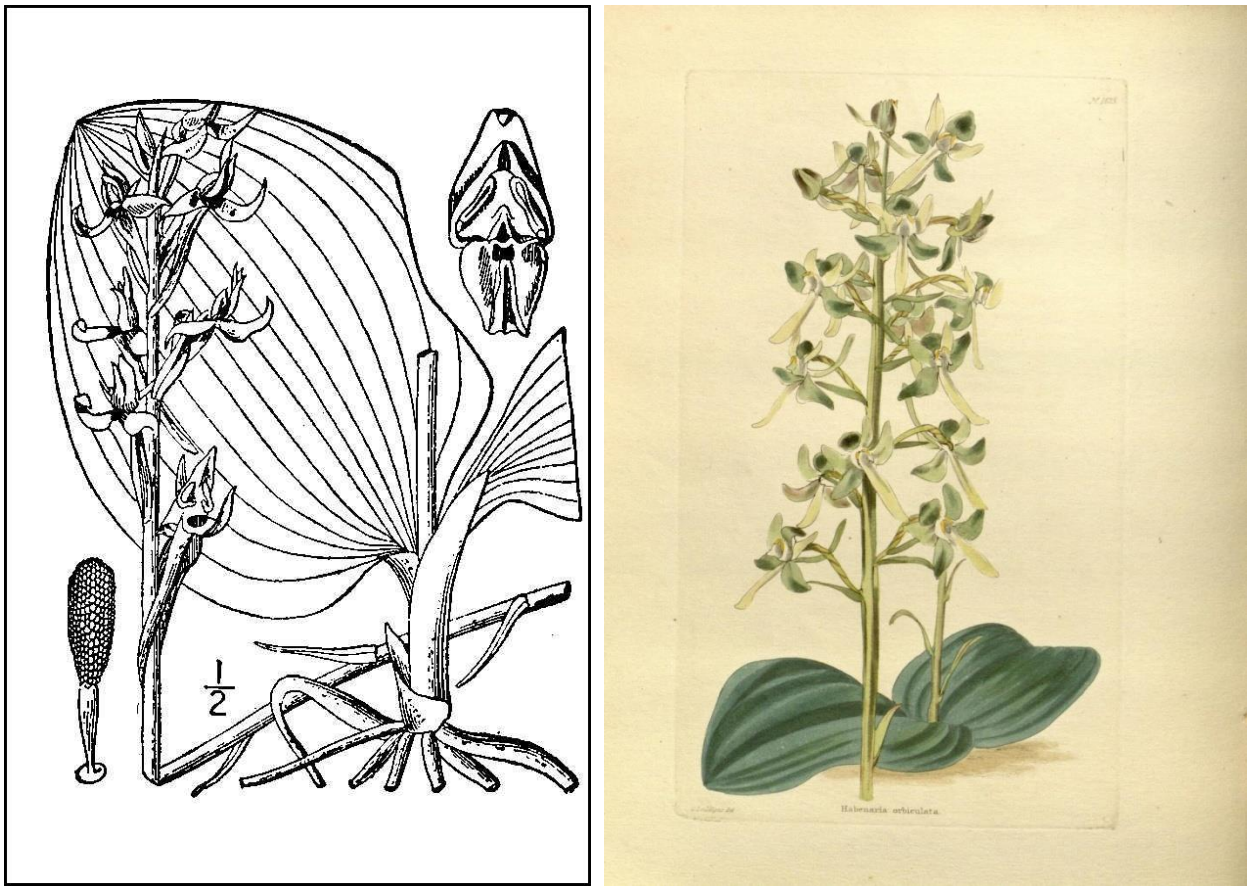

Sequoia Janirella Wrens, 2020.

Other basal-leaved rein orchids which could be confused with *Platanthera orbiculata* include *P. hookeri* and *P. macrophylla*. *Platanthera hookeri* can be separated from the other two species by its bractless stems and yellow-green flowers. Spur length is the easiest way to distinguish *P. orbiculata* and *P. macrophylla*, as the spur of the latter species is 28–46 mm long (Ames 1906, Reddoch and Reddoch 1993, Sheviak 2020). *P. hookeri* is presently listed as a historical species in New Jersey and *P. macrophylla* has not been documented in the state (NJNHP 2022, Kartesz 2015).

Cleavitt et al. (2016) described five life stages for *Platanthera orbiculata*. The initial phase is the development of an underground protocorm, followed by a juvenile phase (single linear leaf), an immature phase (single round leaf), a mature vegetative phase (two rounded leaves) and a reproductive phase (two rounded leaves and a raceme). The authors noted that reproductive plants are significantly larger than mature vegetative plants. Round-leaf Orchid spends 3–4 (or more) years in the protocorm stage before developing an aboveground presence (Cleavitt et al. 2016, Berry and Cleavitt 2021). Plants in their juvenile stage may function like spring ephemerals, making an appearance for a few weeks in the early part of the season and then disappearing (Cleavitt et al. 2016). Once *P. orbiculata* plants have reached vegetative or reproductive maturity they can sometimes regress to earlier stages (Reddoch and Reddoch 1997, Cleavitt et al. 2016). Unlike many woodland orchids, *Platanthera orbiculata* seldom remains

dormant for more than a single consecutive season (Reddoch and Reddoch 1997) and plants that do not appear above ground for two years in a row are not likely to be seen again (Berry and Cleavitt 2021).

Mature *Platanthera orbiculata* plants have a large shoot bud, a tapering tuberous root up to 15 cm in length, and 2–7 fleshy cylindrical roots up to 7 cm long that arise where the shoot and tuber are joined (Reddoch and Reddoch 1993, Currah et al. 1990). A bud for the following year is set during August (Cleavitt et al. 2016). At the beginning of the growing season the bud produces a shoot, a tuber, and two root primordia, and as the season progresses the tuber and roots elongate and several additional roots may also be formed (Currah et al. 1990). Reproductive individuals bloom between June and August (Hough 1983, Brackley 1985) and healthy plants can flower for several consecutive years (Cleavitt et al. 2016). Bowles and Armstrong (2019) observed that *P. orbiculata* flowers are long-lasting. The fruits usually develop in September (Hough 1983) and release their seeds during early October (Reddoch and Reddoch 1997).




Left: Britton and Brown 1913, courtesy USDA NRCS 2022a. Right: George Cooke, 1830.

## Pollinator Dynamics

Most *Platanthera* species are pollinated by moths or butterflies (Dressler 1981), and the lengths of the floral spurs may correspond to the tongue lengths of specific pollinators (Brackley 1985,

Reddoch and Reddoch 1993). The pale, lightly fragrant flowers of *Platanthera orbiculata* are pollinated by nocturnal moths (Andrews 1901, Brackley 1985, Hapeman and Inoue 1997). Each club-shaped mass of pollen grains (pollinium) is attached to a flexible stalk (caudicle) that has a sticky disc on the other end. The paired pollinia are situated perfectly to come into contact with the visitors' eyes as they access the nectar secreted at the bottom of the spurs. The outward-facing discs adhere to the insect as it leaves and then drying of the caudicles causes them to rotate downward and inward, positioning them to deposit the pollen clusters on the next flower visited (Gray 1879, Brackley 1985). Self-fertilization may be inhibited by the time required for the stalks to bend (Catling and Catling 1991). A study of *Platanthera blephariglottis* found that caudicle movement was completed in about a minute, which exceeded the amount of time that most pollinators spent on an individual inflorescence (Cole and Firmage 1984). Brackley (1985) thought that self-fertilization was unlikely in *P. orbiculata*, but there are a number of species in the genus that can self-pollinate (Catling and Catling 1991).

Gray (1879) used *Sphinx drupiferum* as an example of a suitably-sized moth for *Platanthera orbiculata* but did not identify the insect as pollinator, although it was subsequently cited as one by some other authors—particularly those who treated *P. macrophylla* as a synonym of *P. orbiculata* (e.g. Brackley 1985). Reddoch and Reddoch (1993) noted that the most reliable characteristics for separating *P. orbiculata* and *P. macrophylla* were the lengths of their spurs and pollinia, and that the elongate tongue of *Sphinx drupiferum* was a better match for *P. macrophylla*. Warren Stoutamire collected two noctuid moths pollinating *P. orbiculata* (Hapeman 1996) and the two species (*Autographa ampla* and *Diachrysia balluca*) are currently the only confirmed pollinators for the orchid (Hilty 2020, Pace 2020, NAOCC 2022). *Diachrysia balluca* has been documented in New Jersey, but no records were found for *Autographa ampla* although the state lies within the boundaries of the moth's known range (BugGuide 2022, NAMPG 2022). Bergum et al. (2018) reported a plume moth (*Amblyptilia pica*) visiting *P. orbiculata* flowers in New Hampshire but it was not clear whether the insect was a pollinator or a nectar thief.

Left: Flower with pollinia by Sequoia Janirella Wrens, 2020. Right: *Diachrysia balluca* (Hologram Moth or Green-patched Looper) from Sussex County, NJ by J. S. Dodds, 2018.

The orchid's narrow pollinator requirements may limit seed production. Studies of a New Hampshire population spanning multiple years found that only 33.5% of flowers were pollinated, and a typical inflorescence bearing 18.9–20.4 flowers produced an average of 2.5 viable fruits (Cleavitt et al. 2016, Berry and Cleavitt 2021).

## Seed Dispersal and Establishment

The fruits of *Platanthera orbiculata* are tan or brown capsules 1.5–2 cm long that are erect at maturity and the seeds are dark brown (Fernald 1950, Reddoch and Reddoch 1997). Most orchids produce numerous tiny propagules known as dust seeds which lack endosperm and consist mainly of an embryo surrounded by a loose, papery coating (Dressler 1981). The capsules of *P. orbiculata* typically contain over 2,000 seeds: Means of 2,223 and 2,061 seeds per capsule were reported by Cleavitt et al. (2016) and Berry and Cleavitt (2021) respectively.

Wind is the primary means of dispersal for the seeds, shaking them out of the capsules and then transporting them to new locations (Stoutamire 1964, Dressler 1981). Orchid seeds have relatively large internal air spaces that permit them to float in the air for long periods. Arditti and Ghani (2000) found that 81% of the internal volume of typical *Platanthera* seeds is free air space. Although their structure suggests a potential for long-distance dispersal, the majority of orchid seeds travel for relatively short distances. Experiments conducted by Brzosko et al. (2017) determined that the seeds of *Platanthera bifolia* traveled a maximum distance of six meters and 96–99% landed within two meters of the parent plants: Comparable results were obtained for other orchid species tested. The seeds of *P. orbiculata* also tend to disperse in the highest densities in close proximity to the source (Berry and Cleavitt 2021). Inflorescence height and physical barriers in the community can influence the wind dispersal distance of orchid propagules (Brzosko et al. 2017).

Limited dispersal of seeds may also occur by other means. For example, many orchid seeds also have a water-resistant outer surface that—together with the internal air space—permits flotation, allowing some movement of seeds via surface water after a rain. The seeds of *Platanthera orbiculata* apparently have the ability to float on water, although the duration was not reported (Arditti and Ghani 2000). Arditti and Ghani also noted that the general characteristics of orchid seeds suggest the possibility of transport by adherence to land animals or birds.

Dormancy in orchid seeds varies between species, ranging from 0–7 years (Eriksson and Kainulainen 2011). Dressler (1981) noted that the seeds of orchids may survive for long periods if they are cool and dry. However, Berry and Cleavitt (2021) observed that dormancy appeared to be negligible in *Platanthera orbiculata*. When orchid seeds become hydrated limited metabolic activity is initiated but establishment requires appropriate physical conditions and, in nature, the right kind of fungi (Dressler 1981, Arditti and Ghani 2000). Germination in *Platanthera* species is usually inhibited by light (Rasmussen 1995). A relatively high proportion of orchid seeds initiate germination but fail to develop (Rasmussen and Whigham 1993, Jersáková and Malinová 2007). *Platanthera* seeds can germinate in the absence of fungi, producing long epidermal hairs that could become sites for fungal contact, but formation of protocorms does not occur without symbionts (Zelmer et al. 1996). Relatively high rates of

initial seed germination (48%) were observed in *Platanthera orbiculata* (Cleavitt et al. 2016) but very few (0.96%) were able to develop protocorms (Berry and Cleavitt 2021). Sharma et al. (2003) indicated that 0–3% of *Platanthera* seeds are likely to reach the leaf-bearing seedling stage.

It is not clear whether *Platanthera orbiculata* requires a specific fungal associate in order to develop. Fungi identified from the roots of mature *P. orbiculata* plants included *Leptodontidium orchidicola* and *Sebacina* sp. (Currah et al. 1990), both of which are wood decomposers (Lesher and Henderson 1998). Rasmussen (1995) noted that neither species had been tested for a role in seedling development although *Sebacina vermifera* had been known to fulfill that function in some Australian orchids. Zelmer et al. (1996) found evidence that *Platanthera* plants can form relationships with more than one fungus simultaneously, noting that seedlings might associate with different fungi than mature plants and might also select their fungal partners depending upon availability. Rasmussen and Rasmussen (2009) pointed out that some orchids may have a narrower host range during their establishment phase, and that much more study of that critical stage was needed.

## Habitat

*Platanthera orbiculata* can be found at elevations ranging from 0–1500 meters, where it typically occurs in mesic to wet forests that may be dominated by deciduous or evergreen species (Fairbrothers and Hough 1973, Hough 1983, Brackley 1985, Reddoch and Reddoch 1993 and 1997, Rhoades and Block 2007, Sheviak 2020, Weakley et al. 2022). The forest floor is often deeply shaded (Lesher and Henderson 1998, Hornbeck et al. 2003, NJNHP 2022). While alkaline substrates may be favored (Weakley et al. 2022), the soil reported from one Rhode Island habitat was acidic with a pH ranging from 4.5–4.9 (Stuckey 1967). Bowles and Armstrong (2019) noted that *P. orbiculata* usually occurs in small, isolated colonies and Brackley (1985) observed that the orchids were often found growing near the bases of large trees. Atypical habitat was reported from a Lodgepole Pine (*Pinus contorta*) stand in the Canadian Rocky Mountains where the orchid had established in a xeric microsite (Gendreau-Berthiaume et al. 2015).

Data from herbarium sheets examined by Reddoch and Reddoch (1993) showed that Round-leaf Orchid can occur in a wide variety of forest types. The dominant canopy species recorded included an assortment of evergreens (*Abies balsamea, Larix laricina, Picea* spp., *Pinus* spp., *Thuja occidentalis, Tsuga canadensis*) and deciduous trees (*Acer* spp., *Fagus grandifolia, Populus* spp.). A New Jersey population was found beneath a canopy dominated by *Quercus* spp. and *Acer saccharum* near the edge of a swamp (NJNHP 2022). In southeastern Alaska, characteristic habitat for the orchid is Western Red Cedar (*Thuja plicata*) forest (Bowles and Armstrong 2019).

Many of the forests that support populations of *Platanthera orbiculata* are well-established. In the northwestern United States, the species was most often found in mature to old growth stands over 130 years old, although stand ages ranged from 54–837 years (Lesher and Henderson 1998). The New Hampshire forest supporting the *P. orbiculata* population studied by Cleavitt et al.

(2016) was about 100 years old. Occurrences in the Black Hills of South Dakota and Wyoming were frequently associated with mid- to late-successional *Betula papyrifera/Corylus cornuta* communities that often had an overstory of *Picea glauca* (Hornbeck et al. 2003).

## Wetland Indicator Status

*Platanthera orbiculata* is a facultative species, meaning that it occurs in both wetlands and nonwetlands (U. S. Army Corps of Engineers 2020).

## USDA Plants Code (USDA, NRCS 2022b)

PLOR4

## Coefficient of Conservatism (Walz et al. 2018)

CoC = 10. Criteria for a value of 9 to 10: Native with a narrow range of ecological tolerances, high fidelity to particular habitat conditions, and sensitive to anthropogenic disturbance (Faber-Langendoen 2018).

## Distribution and Range

The global range of *Platanthera orbiculata* is restricted to the United States and Canada (POWO 2022). The map in Figure 1 depicts the extent of Round-leaf Orchid in North America.

The USDA PLANTS Database (2022b) shows records of *Platanthera orbiculata* in two New Jersey counties: Bergen and Sussex (Figure 2). The data include historic observations and do not reflect the current distribution of the species.

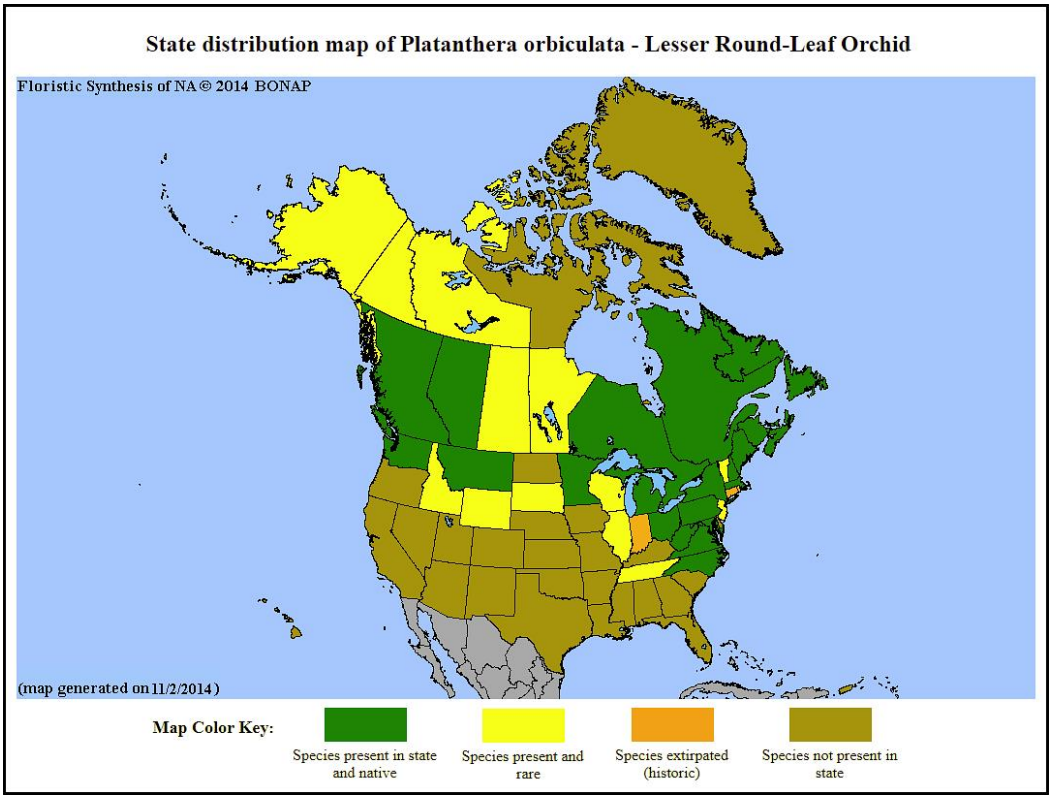



*Figure 1. Distribution of P. orbiculata in North America, adapted from BONAP (Kartesz 2015).*

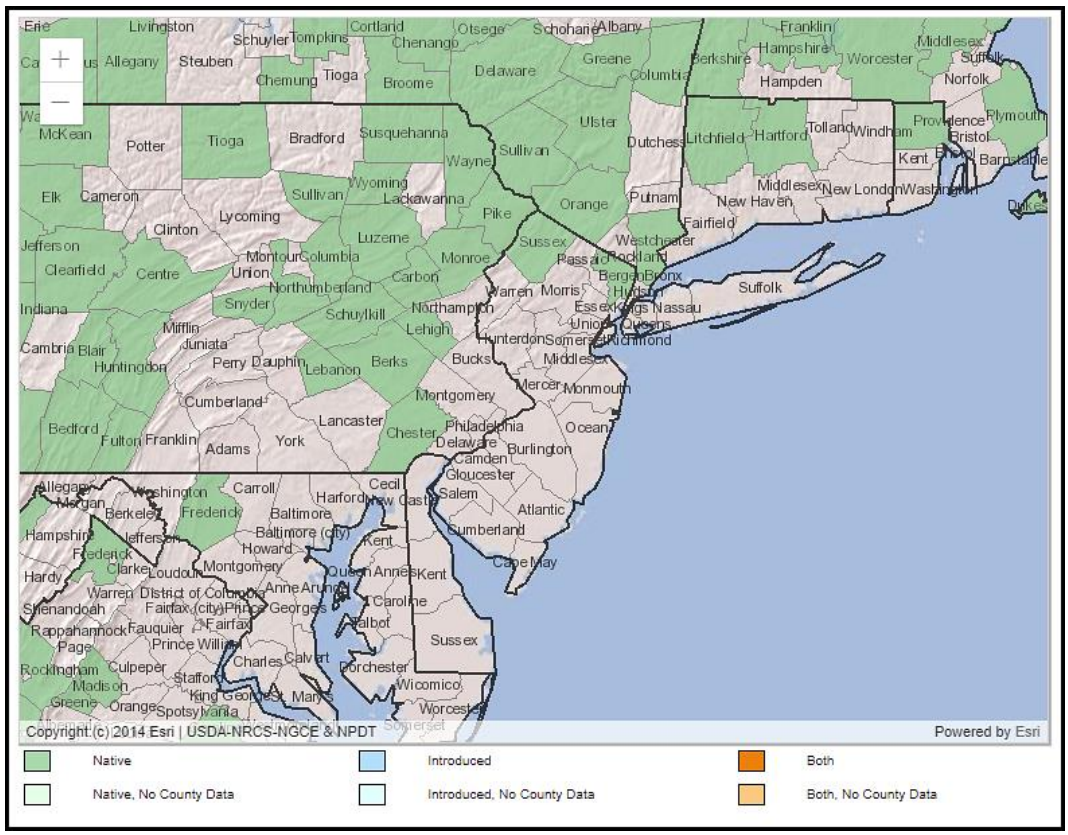



*Figure 2. County records of P. orbiculata in New Jersey and vicinity (USDA NRCS 2022b).*

## Conservation Status

*Platanthera orbiculata* 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 2022). The map below (Figure 3) illustrates the conservation status of *P. orbiculata* throughout its range. Round-leaf Orchid is vulnerable (moderate risk of extinction) in six states and three provinces, critically imperiled (very high risk of extinction) in three states, possibly extirpated in three states, and likely extirpated in Indiana. In other districts where the species occurs it is apparently secure or has not been ranked.

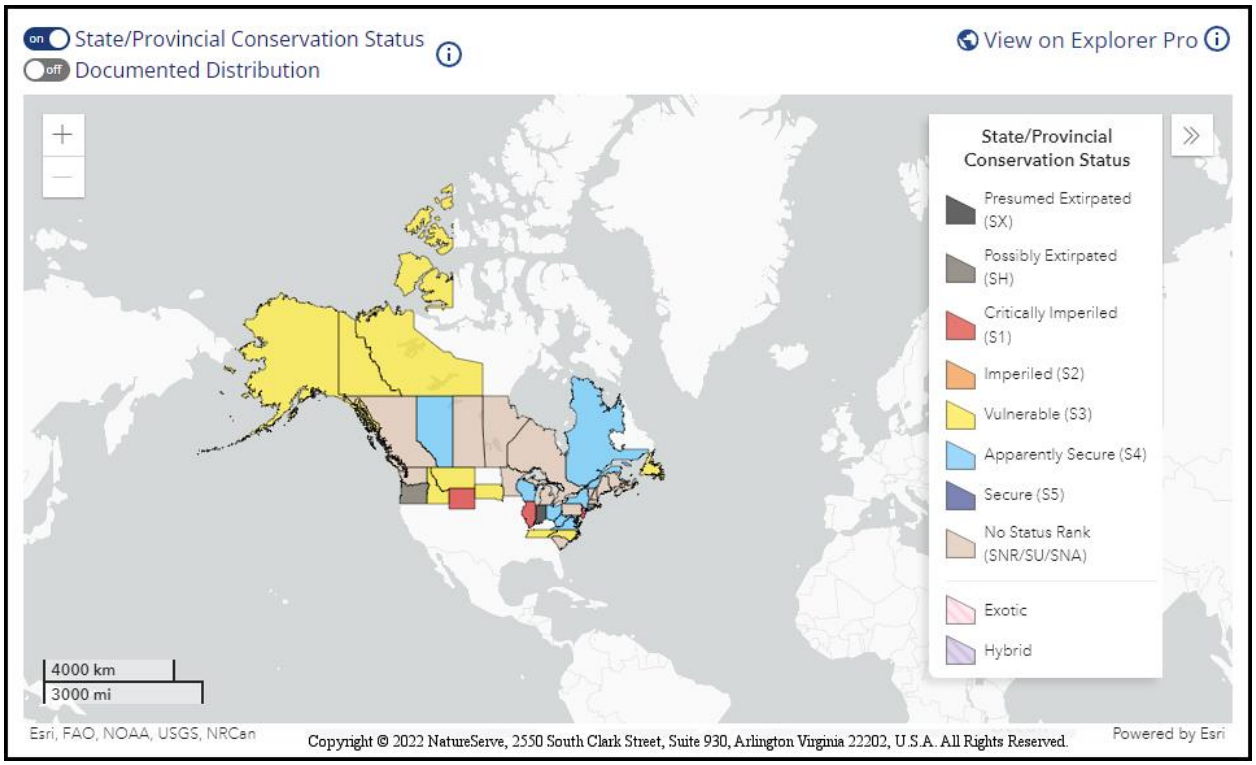



*Figure 3. Conservation status of P. orbiculata in North America (NatureServe 2022).*

New Jersey is one of the states where *Platanthera orbiculata* is critically imperiled (NJNHP 2022). The S1 rank signifies five or fewer occurrences in the state. A species with an S1 rank is typically either restricted to specialized habitats, geographically limited to a small area of the state, or significantly reduced in number from its previous status. *P. orbiculata* 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 the orchid signify that the species is eligible for protection under the jurisdictions of the Highlands Preservation Area (HL) and the New Jersey Pinelands (LP) (NJNHP 2010).

Britton (1889) reported New Jersey records of *Platanthera orbiculata* from two sites in Sussex County and one in Bergen but Taylor (1915) indicated that the Bergen record was an old one.

Fables (1956) said that *P. orbiculata* was one of the rarest plants in the state, noting that several former colonies had been destroyed and only a single population remained. Round-leaf Orchid was initially identified as an endangered species by Fairbrothers and Hough (1973), who reported that the orchid was still only known from a single site in the state despite diligent searching by botanists. The 1980 discovery of a single plant added a new location and two small populations are presently considered extant in New Jersey, both located in Sussex County (NJNHP 2022).

## Threats

New Jersey's populations of *Platanthera orbiculata* face a particularly high risk of extinction due to their small size and relative isolation. Limited opportunities for outcrossing typically lead to reduced genetic variation, making the plants less resilient to changes in their environment (Ellstrand and Elam 1993). Small populations may also attract fewer pollinators (Rathke and Jules 1993), exacerbating the problem, and that could be especially challenging for a species like *P. orbiculata* that depends on a narrow selection of insects for cross-fertilization. Colonies consisting of only a few individuals are also more likely to be eliminated by chance events. A study of 359 rare plant occurrences in Germany confirmed the prediction of various models that colony size can play a significant role in the survival or demise of local plant populations (Matthies et al. 2004). Studies in New Hampshire, where *P. orbiculata* is not presently considered rare, reported high mortality rates in juvenile and immature plants and an analysis of mortality at various life stages projected an average annual population decline of 6% (Cleavitt et al. 2016, Berry and Cleavitt 2021).

Herbivory by White-tailed Deer (*Odocoileus virginianus*) has been identified as a threat to *Platanthera orbiculata* in New Jersey (NJNHP 2022). Knapp and Weigand (2014) indicated that deer were the probable cause of extirpation for nine Maryland populations of Round-leaf Orchid, and the Ontario population that had been studied by Reddoch and Reddoch was subsequently lost to deer browse (Cleavitt et al. 2016). Deer were not reported as a significant concern at the site studied by Cleavitt et al. (2016), who noted that most observed leaf damage was caused by slugs or fungi, but Berry and Cleavitt (2021) later reported an increased loss of mature plants to deer browse in the same population. A deer exclusion study in an Appalachian forest found that *P. orbiculata* was present in one of six fenced plots but was absent from all of the control plots (Wilbur et al. 2017). In Alaska, both deer and grouse have been known to dig up and remove the orchids entirely (Fulkerson et al. 2017). Regardless of the cause, *P. orbiculata* plants that experience leaf damage or loss are likely to regress to an earlier life stage or disappear by the next growing season (Cleavitt et al. 2016).

A number of additional threats to *Platanthera orbiculata* have been reported throughout its range. Timber harvesting and other forest management practices are often cited as concerns (Reddoch and Reddoch 1997, Caplow 2002, Hornbeck et al. 2003, Fulkerson et al. 2017). Lilles et al. (2018) found that harvesting led to declines in *P. orbiculata* and that clear-cutting was particularly detrimental, although damage to orchid populations could be limited by retaining at least 40% of the overstory. Loss of habitat for Round-leaf orchid has also been attributed to land use conversion, road or trail development, mining, and grazing (Caplow 2002, Fulkerson et al.

2017). Indiscriminate spraying for the control of insect pests may reduce pollinator availability (Lesher and Henderson 1998, Hornbeck et al. 2003, Knapp and Weigand 2014). In some locations invasive plants were noted as a problem, particularly along trails or openings created by other disturbances (Hornbeck et al. 2003, Knapp and Weigand 2014). Natural disturbances such as hydrologic changes resulting from beaver activity could also eliminate populations at certain sites (Reddoch and Reddoch 1997).

The pressures on *Platanthera orbiculata* are likely to be exacerbated by climate change. Habitats in New Jersey are being affected by higher temperatures, more frequent floods, and lengthier droughts (Hill et al. 2020) which could have direct impacts on plant vigor and might also change the composition of the fungal communities on which the orchids depend (Lesher and Henderson 1998, Hornbeck et al. 2003, Berry and Cleavitt 2021). If warming trends extend the growing season in some regions, a loss of synchronicity with the life cycles of its specialist pollinators could place additional limits on the reproductive capacity of *P. orbiculata* (Adams and Parisio 2013).

## Management Summary and Recommendations

In areas where *Platanthera orbiculata* is imperiled, the remaining populations should be closely monitored so that action can be taken to prevent catastrophic population declines. The two populations considered extant in New Jersey were both down to a single plant when last observed and—as dormancy is uncommon in the species and seed banking is rare in orchids—the prospects for long-term persistence of those occurrences appear to be poor. Slow population declines such as the one documented by Berry and Cleavitt (2021) could be taking place in other states or provinces where *Platanthera orbiculata* is vulnerable. Considerations for the management of threatened occurrences might include land preservation, protection from predation, and removal of invasive plant species.

*Platanthera orbiculata* is a species for which offsite propagation and reintroduction may be an appropriate conservation measure. As previously noted, the natural rates of reproduction and establishment are low in the species and disturbances that result in the loss of mature plants are likely to result in negative population growth. Although growing terrestrial orchids is often a complex process, *P. orbiculata* can apparently be propagated successfully by division or by seed (Easter 2014, NCSU Extension 2022). However, attempts by Smreciu and Currah (1989) to germinate Round-leaf Orchid seeds were largely unsuccessful. Propagation by an experienced horticulturalist using native stock is recommended if restoration efforts are considered.

Efforts to conserve *Platanthera orbiculata* could be strengthened by additional research. At present, identification of *P. orbiculata*'s specialist pollinators is based on a single record from an Ohio botanist but specific insect relationships have not been studied throughout the range of the orchid. Round-leaf Orchid's range of tolerance to variations in environmental and climactic conditions is relatively unknown. McCormick and Jacquemyn (2014) also pointed out that our understanding of *P. orbiculata* and other terrestrial orchids is limited by the breadth of our knowledge concerning the ecology of the fungal communities that support the rare plants.

## Synonyms

The accepted botanical name of the species is *Platanthera orbiculata* (Pursh) Lindl. Orthographic variants, synonyms, and common names are listed below (ITIS 2021, POWO 2022, USDA NRCS 2022b). *Platanthera macrophylla* is occasionally identified as a variety of *P. orbiculata* (e.g. POWO 2022) but most sources now treat it as a distinct species.

| Botanical Synonyms | Common Names |
|---|---|
| *Habenaria orbiculata* (Pursh) Hook. | Round-leaf Orchid |
| *Habenaria orbiculata* var. *lehorsii* Fernald | Lesser Roundleaved Orchid |
| *Habenaria orbiculata* var. *menziesii* (Lindl.) Fernald | Lesser Round-leaf Orchid |
| *Lysias orbiculata* (Pursh) Rydb. | Round-leaved Rein Orchid |
| *Orchis orbiculata* Pursh | Dessert-plate Orchid |
| *Platanthera orbiculata* var. *orbiculata* (Pursh) Lindl. | |

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