

Triphora trianthophoros

Three Birds Orchid

Orchidaceae



Triphora trianthophoros courtesy Alan Cressler, Lady Bird Johnson Wildflower Center

***Triphora trianthophoros* 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

Triphora trianthophoros (Three Birds Orchid) is a subterranean perennial plant seldom seen above ground. The plants grow, store nutrients, and vegetatively reproduce below the surface. The primary structures of *T. trianthophoros* are tuberoids, thickened storage organs that develop from root tissue (Dressler 1981). Each plant consists of two to many tuberoids that are attached to one another by slender stolons. Two kinds of tuberoids are produced: The primary tuberoid is tan in color while the secondary tuberoids are a waxy white (Williams 1994). A primary tuberoid contains an apical bud that may form shoots multiple times throughout its life but can go for years without producing an aboveground stem. Secondary tuberoids grow as the plants age and may eventually become detached, forming the primary tuberoids of new plants (clones). Following a comprehensive study of the species' life belowground, Williams (1994) reported that a single plant may have as many as 17 secondary tuberoids. She also determined that the majority of plants in a typical population do not form shoots in any given year.

When a *Triphora trianthophoros* plant does develop an aboveground stem it usually flowers, although vegetative plants with only one small leaflet are sometimes produced (Williams 1994). The stems appear during late summer and vary in height, with some barely reaching the surface of the leaf litter and others growing up to 20 cm tall (Philipps, undated). Each stem develops 2–8 alternate, ovate, clasping leaves and 1–7 flowers on axillary peduncles (Britton and Brown 1913). Williams (1994) found that the stems originating from larger tuberoids produce more numerous flowers. The flower sepals and upper petals are lanceolate in shape and white with pinkish edges, the expanded lower petal (lip) is roughish above and marked with three longitudinal green lines, and the pollen is purple (Fernald 1950). Typical stems and leaves are green and tinged with maroon or purple (Godfrey and Wooten 1981, Medley 2020) but occasionally plants develop with white stems and leaves and pure white petals with yellow lines instead of green on the lip (Keenan 1992). Flowering may take place from July through September (Rhoads and Block 2007, Weakley 2015) but mid-August to September is typical in New Jersey (Hough 1983). The blossoms of unpollinated flowers fall off after about five days, but those of fertilized flowers dry out and remain attached to the developing fruit. Aboveground stems produced by *T. trianthophoros* generally complete fruit set a month after emergence (Williams 1994) and the seed pods do not persist through the winter (Williams 1998).

Because leaf production is minimal and occurs while the forest floor is shaded, *Triphora trianthophoros* plants can only engage in limited photosynthetic activity during their brief forays above the surface. While nearly all orchids are reliant on mycorrhizae during the establishment phase and the majority continue to maintain those associations throughout their lives (Dressler 1981, Batty et al. 2002), the largely subterranean lifestyle of *T. trianthophoros* makes the species particularly dependent on mycorrhizae for all of its energy requirements. In *Triphora* species nutrients are supplied by mycorrhizae located in the root cortex (Carlsward and Stern 2009) although a specific fungal associate has not been identified (Batty et al. 2002).

Colonies of *Triphora trianthophoros* may persist for years without producing stems (Snyder 1993, Chafin 2020), and even when they do briefly appear the small plants can be easily overlooked when not in flower. Porcher (1977) discovered Three Birds Orchid in a region of South Carolina where it had not been reported for 125 years, and Coddington and Field (1978)

thought it likely that the plant was still extant at sites where it had not been seen in 50 years because the species is so easily missed. Even at known locations, colony sizes may appear to fluctuate widely between years (Keenan 1990, Snyder 2000, Jones et al. 2016), making it extremely difficult to assess the size and status of a population.



Left: Illustration courtesy of New York Botanical Garden. Right: Photo courtesy Alan Cressler, Lady Bird Johnson Wildflower Center.

Pollinator Dynamics

All species of *Triphora* that do not self-pollinate are gregarious bloomers and the simultaneous flowering probably helps to attract pollinators (Dressler 1981). Like other members of the genus, *T. trianthophora* flowers are short-lived and seldom last for more than a day (Medley 2020). Because only one or two (occasionally three) buds per plant open at once, a population can experience several mass blooms over the course of two or three weeks with intervals of several days between each event (Keenan 1986). Synchronous flowering in Three Birds Orchid may be triggered by climactic cues: Keenan (1986) noted that blooming was often preceded by a cold night and Jones et al. (2016) reported that flowers usually open on the second morning after a significant drop in overnight temperature. In another gregariously blooming orchid, *Dendrobium crumenatum*, flower buds develop to a certain stage and then halt until cued by the

right set of weather conditions after which all of the buds that had paused resume development at the same stage (Dressler 1981). By consulting with colleagues around New England, Keenan (1992) learned that cohorts of *T. trianthophoros* flowers had opened simultaneously in Maine, New Hampshire, and Massachusetts populations.

Many kinds of bees have been reported as pollinators of *Triphora trianthophoros*. The majority are sweat and furrow bees in the genera *Lasioglossum*, *Augochlora*, *Halictus*, *Dialictus*, and *Sphecodes* but a small carpenter bee (*Ceratina dupla*), a miner bee (*Andrena sp.*) and a bumblebee (*Bombus sp.*) have also been observed (Lownes 1920, Jones et al. 2016, Medley 2020, Pace 2020, Hilty 2020, NAOCC 2022). A *T. trianthophoros* flower has ultraviolet markings that guide bees into its floral tube (NAOCC 2022). As a bee enters the flower the orchid's pollen packet becomes loosened but not detached, and when the insect exits the pollinia adheres to its thorax and is deposited on the stigma of the next flower it visits (Lownes 1920, NAOCC 2022).

Keenan (1992) noted that only a small percentage of *T. trianthophoros* flowers produced fruit. The observation was substantiated by Williams (1994), who found that over a five year period roughly 5% of the plants that initiated flowering completed the production of seed pods.

Seed Dispersal

Copious seed production may help to compensate for low fruiting rates. The fruit of *Triphora trianthophoros* is an oval capsule containing thousands of tiny seeds (Britton and Brown 1913, Jones et al. 2016). The dust-like seeds are released through longitudinal slits in the capsule then dispersed by the wind, and their small size allows them to remain airborne for long periods of time (Williams 1998, Jones et al. 2016, Chafin 2020).

As with many other orchids, the seeds of *T. trianthophoros* lack endosperm and require a mycorrhizal relationship in order to establish (Chafin 2020). Wherever a seed lands, the presence or absence of an appropriate fungus will determine whether a seedling can establish and develop (Batty et al. 2002). This phase of Three Birds Orchid's life cycle is poorly documented, which is not surprising considering the minute seeds and the fact that development proceeds underground. Batty et al. (2002) note that for orchids in general, germination is likely to coincide with periods of high fungal activity in the soil and to occur early enough to permit production of a structure capable of surviving until the next growing season. Such exacting requirements for establishment make the species a poor colonizer, at least partially explaining its failure to appear in seemingly suitable habitats (Coddington and Field 1978).

A potential means of vegetative dispersal has also been identified for *T. trianthophoros*. Jones et al. (2016) reported that the orchid's tuberosities are known to be collected and cached by squirrels, which could result in the plant's establishment at new locations since the organs are capable of producing new growth.

Habitat

Triphora trianthophoros can occur on level or sloping terrain in a variety of dry to moist forested habitats at elevations from 0–2000 meters (Medley 2020). The canopy may be dominated by deciduous species such as American Beech (*Fagus grandifolia*), Sugar Maple (*Acer saccharum*), birches (*Betula spp.*) and oaks (*Quercus spp.*) (Porcher 1977, Dister 2006, MENAP 2021, NYNHP 2019, NJNHP 2022) or by evergreen species such as hemlocks (*Tsuga spp.*), Tamarack (*Larix laricina*), and Great Laurel (*Rhododendron maximum*) (Weakley 2015, Chafin 2020, Medley 2020). Three Birds Orchid is often associated with rotted logs (Fairbrothers and Hough 1973, Godfrey and Wooten 1981, Keenan 1990, Weakley 2015) or depressions where mats of leaves collect and decompose (Keenan 1990, NYNHP 2019, MENAP 2021). The humus-rich substrates are likely to contain the fungi required by the orchid for establishment and development.

Wetland Indicator Status

The U. S. Army Corps of Engineers (2020) 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). *Triphora trianthophoros* has more than one wetland indicator status within the state. In the Eastern Mountains and Piedmont region, *T. trianthophoros* is listed as an upland species, meaning that it almost never occurs in wetlands. In the regions that encompass the rest of New Jersey it is a facultative upland species, meaning that it usually occurs in nonwetlands but may occur in wetlands (U. S. Army Corps of Engineers 2020).

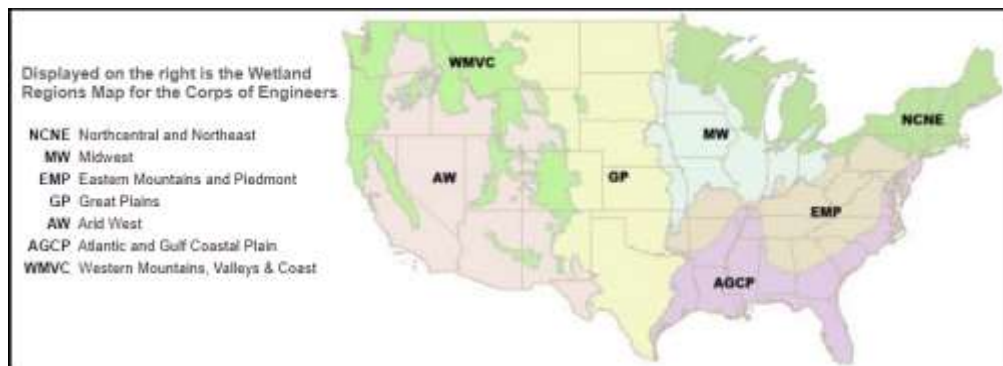


Figure 1. Mainland U. S. wetland regions, adapted from U. S. Army Corps of Engineers (2020).

USDA Plants Codes (USDA, NRCS 2022)

TRTR17 (*Triphora trianthophoros*)

TRTR3 (*Triphora trianthophora*)

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 *Triphora trianthophoros* includes North America and Central America. The map in Figure 1 depicts the extent of the orchid in the United States and Canada.

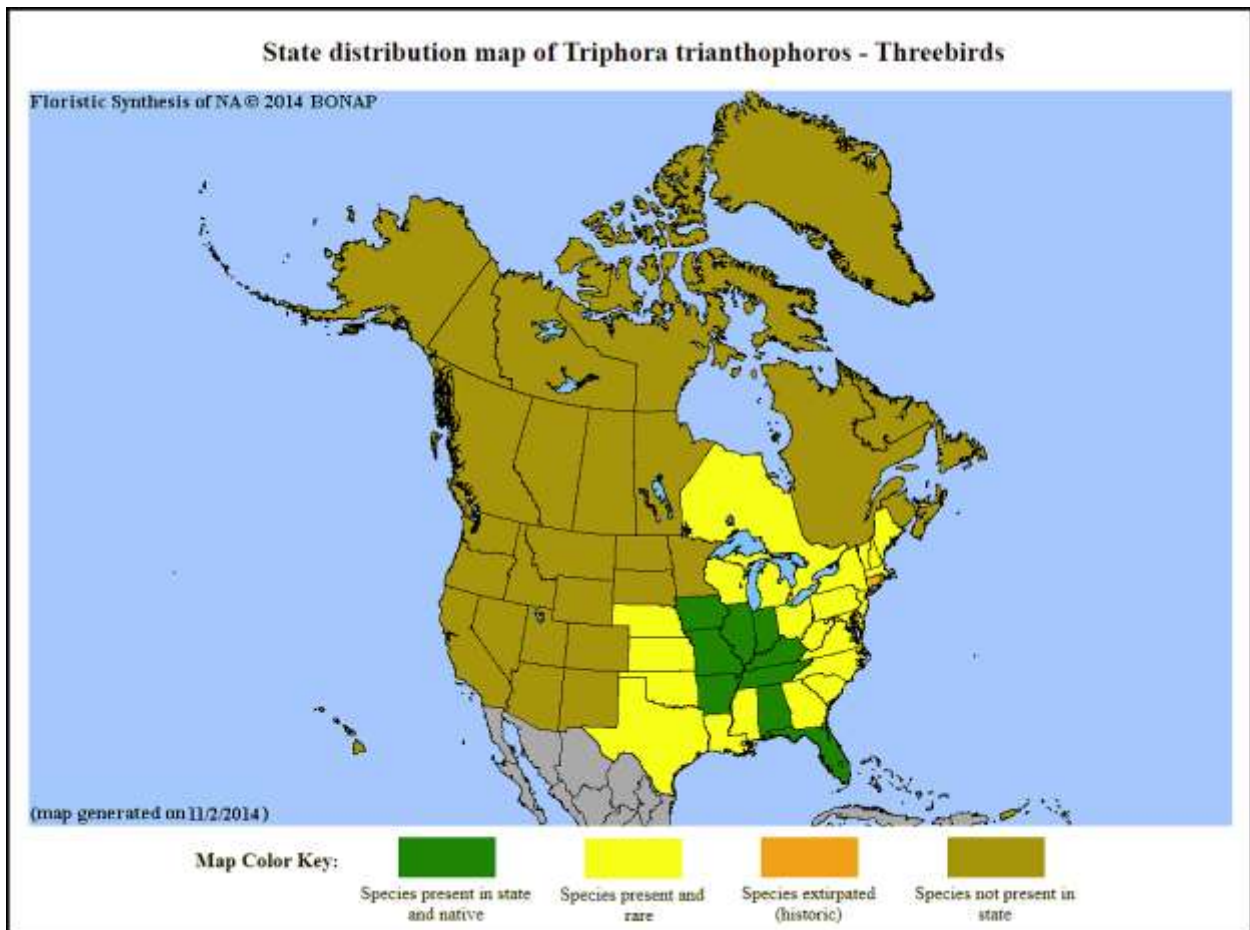


Figure 1. Distribution of *T. trianthophoros* in North America, adapted from BONAP (Kartesz 2015).

The USDA PLANTS Database (2022) shows records of Three Birds Orchid in three New Jersey counties: Bergen, Morris, and Passaic (Figure 2 below). Specimens dating back to the 1800s are also reported from Camden County in the Carnegie Museum of Natural History Herbarium and from the border of Somerset and Mercer Counties in the Field Museum of Natural History in Chicago (Mid-Atlantic Herbaria 2022). Keller and Brown (1905) cited a record from Salem

County. The data include historic observations and do not reflect the current distribution of the species.

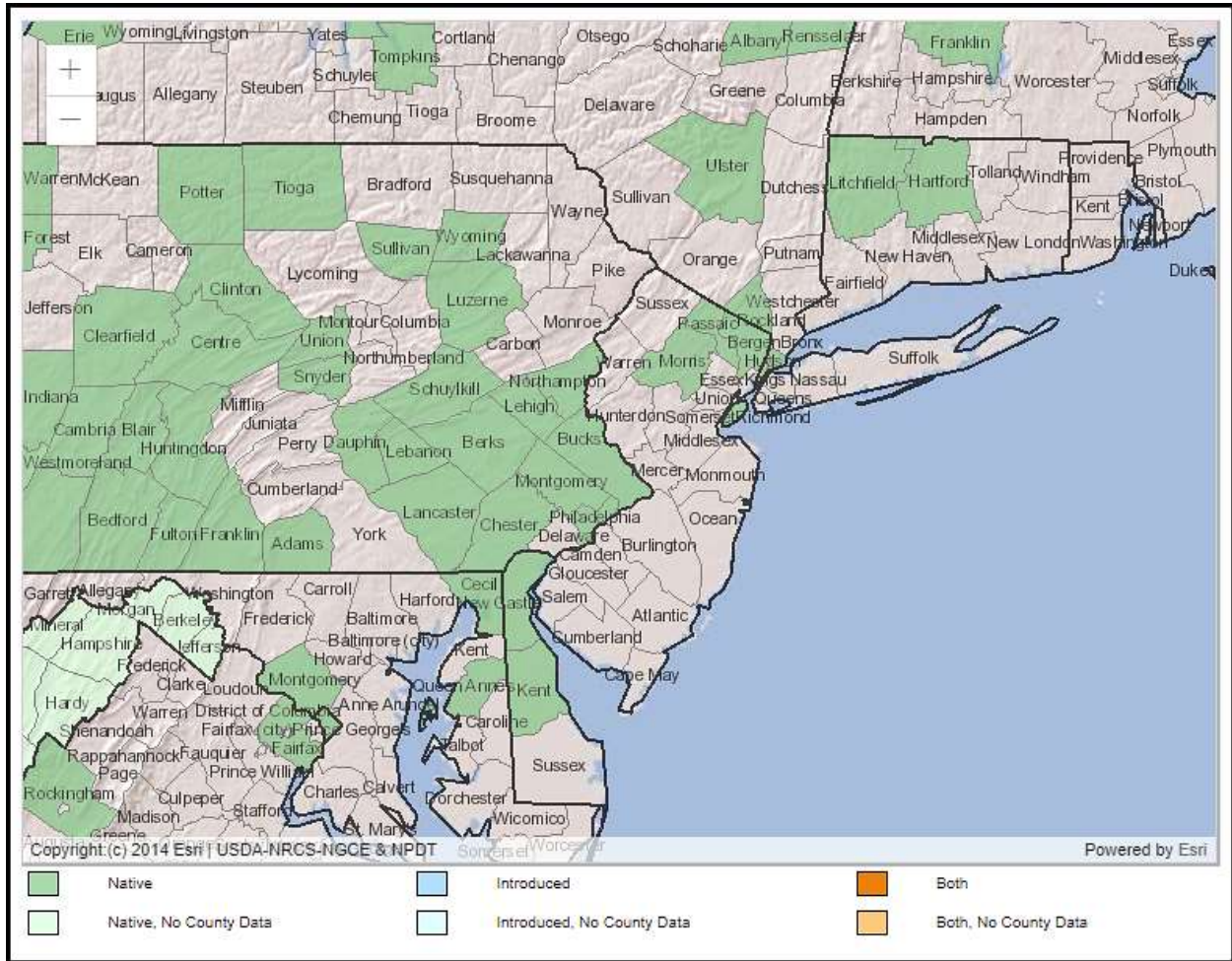


Figure 2. County records of *T. trianthophoros* in New Jersey and vicinity (USDA NRCS 2022).

Conservation Status

Triphora trianthophoros is apparently secure at a global scale. The G4? rank means the species appears to be at fairly low risk of extinction or collapse due to an extensive range and/or many populations or occurrences, although there is some cause for concern as a result of local recent declines, threats, or other factors (NatureServe 2022). The question mark denotes some uncertainty regarding the rank, perhaps in this case due to the difficulty in assessing the status of a cryptic plant. In North America, *T. trianthophoros* has also been identified as a species of highest conservation priority for the North Atlantic region, which includes four Canadian provinces and twelve U. S. states. The orchid has a regional rank of R3 (vulnerable), signifying a moderate risk of extinction (Frances 2017). *T. trianthophoros* is protected at the national level in Canada under the Species at Risk Act of 2002 (Krupnik et al. 2013).

The map in Figure 3 illustrates the conservation status of Three Birds Orchid throughout North America. *T. trianthophoros* is critically imperiled (very high risk of extinction) in ten states and one province, imperiled (high risk of extinction) in nine states, and vulnerable (moderate risk of extinction) in three states. The species is unranked in ten other states. The species is unranked in ten other states.

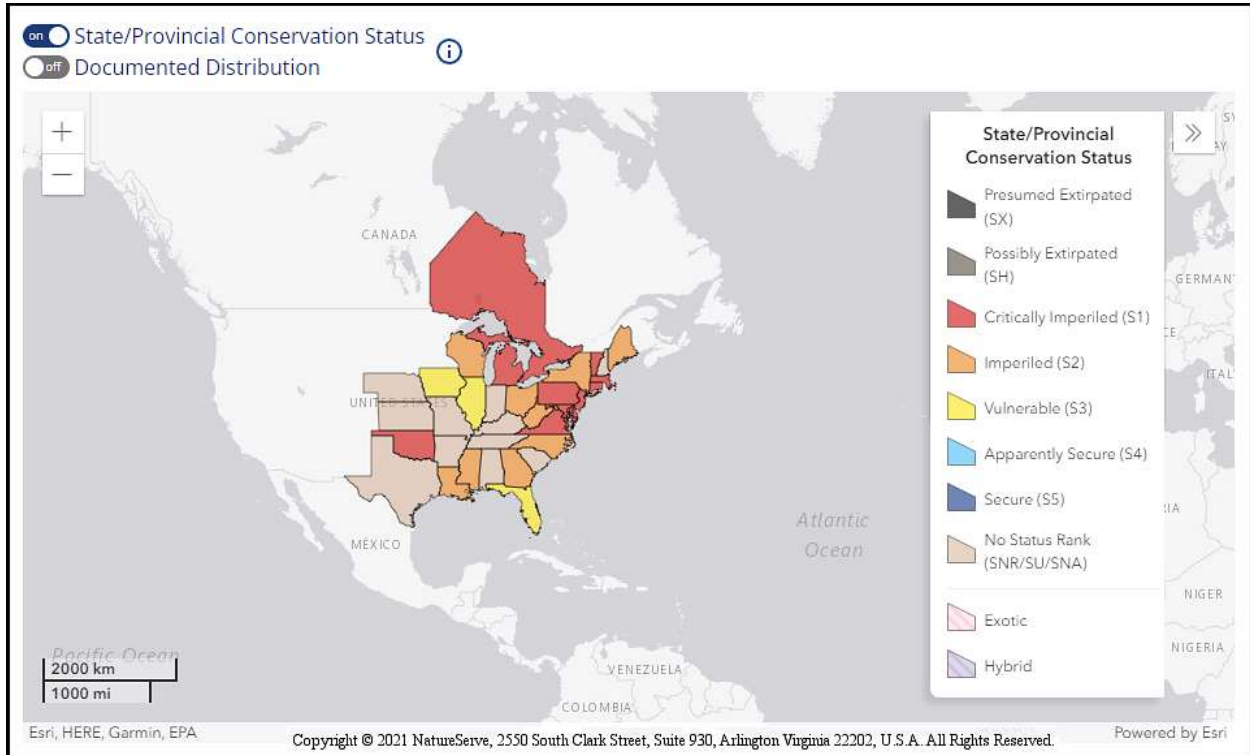


Figure 3. Conservation status of *T. trianthophoros* in North America (NatureServe 2022).

New Jersey is one of the states where *Triphora trianthophoros* 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. *T. trianthophoros* 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, being listed does not currently provide broad statewide protection for 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).

Early lists of New Jersey flora reported *Triphora trianthophoros* from relatively few locations. Britton (1889) noted two locations in Bergen County. Keller and Brown (1905) cited a report from the vicinity of Elmer in Salem County, but the species was not included in Stone's (1911) comprehensive list of southern New Jersey plants. Taylor (1915) noted a single location in Bergen County and one in Morris County. Fairbrothers and Hough (1973) indicated that the species was extant at two sites, one in Morris County and one in Passaic, and ranked it as rare in the state. By 1993 only a single population was confirmed as extant in the state (Snyder 1993),

and that continues to be the sole documented occurrence remaining in New Jersey (NJNHP 2022).

Threats

Triphora trianthophoros rarely flowers and is a poor colonizer, so populations are primarily maintained vegetatively by stolons and tuberooids. The subterranean orchid relies on a thick, rich litter layer and the presence of appropriate fungal associates in order to establish, grow, and reproduce. The fragile plants reside within the litter layer and are often not far from the surface (Williams 1994), so anything that disrupts the substrate may threaten the rare orchid. The species has been threatened by loss of habitat or the destruction of plants resulting from development, logging, forest management, road widening, trampling, livestock grazing, and hog rooting (Jones et al. 2016, Morse et al. 2000, Chafin 2020). A fire hot enough to consume the litter layer could also eliminate a *T. trianthophoros* population.

Certain plant or animal species that alter the characteristics of the litter layer may make the substrate inhospitable for Three Birds Orchid or its obligate fungal associates. For example, introduced earthworms are known to reduce the organic layer, alter the structure and nutrient cycling patterns of soils, and disrupt mycorrhizal processes (Bohlen et al. 2004, Frelich et al. 2006, Hale et al. 2006). Non-native plant species that change soil chemistry such as Japanese barberry (*Berberis thunbergii*) and Garlic Mustard (*Alliaria petiolata*) have been identified as potential threats to the species in Ontario (Jones et al. 2016).

Competition with other native or invasive understory plants has been identified as a potential threat to *T. trianthophoros* (Chafin 2020, Ramstetter 2001). While the orchid requires little light, belowground competition for space, resources, or fungal associates is possible although it has not been specifically studied to date.

Any aboveground stems produced by *Triphora trianthophoros* are at risk of herbivory. Keenan (1986) reported herbivory of the orchid's stems and developing fruits by chipmunks (*Tamias striatus*) and Williams (1994) observed that approximately a third of flower buds produced by the species were lost prior to opening, many to chipmunks or slugs. Herbivory by White-tailed Deer (*Odocoileus virginianus*) was identified as a threat to one Canadian population (Jones et al. 2016). While no reports of belowground herbivory were found, the possibility cannot be ruled out.

Overcollection and removal of plants is a threat to which orchids are particularly vulnerable (PBCCC 1963). Collection has been cited as a threat to *T. trianthophoros* (Morse et al., Ramstetter 2001) and MENAP (2021) noted that, since the species has not been successfully propagated to date, any plants offered for sale were likely to have been dug up from the wild.

Three Birds Orchid was included in a study of species characteristics that can influence the long-term success of rare plants (Farnsworth and Ogurcak 2008). Results of the analysis predicted significant disadvantages for plants that rely on insects for pollination, grow in upland habitats, are limited to local dispersal, or are situated at the southern edge of their range. *Triphora*

trianthophoros shares the first two traits but not the latter two. While those tendencies on their own do not threaten the species, they can contribute to a complex array of factors that may influence its ability to persist. Another inherent disadvantage is the orchid's reliance on clonal reproduction, which is likely to lower the species' genetic diversity. Although that can prove to be beneficial in a stable habitat, it may reduce the probability of adaptation to changing circumstances (Silvertown 1987). It is difficult to predict how shifting climactic conditions might impact *T. trianthophoros* or its fungal associates.

Management Summary and Recommendations

Due to the cryptic nature of *Triphora trianthophoros* and the fact that only a limited number of the plants in a population are likely to emerge in any given year, monitoring may show that the species is present but it cannot accurately assess the status of a population. Site visits should instead focus on suitable habitat conditions such as the presence of a robust litter layer and a lack of disturbance. Williams (1994) was able to confirm the continued presence of the species by gently removing some litter in areas where plants were expected, and that technique could be applied with care under circumstances in which it is necessary to document that the plant is extant. Otherwise it makes sense to assume the species is still present at historic sites based on its record of persisting through long periods of apparent absence at other locations. Protection should continue for sites where the species is considered extant or has recently been known to occur, with management efforts focusing on the prevention of activities that would disturb the community and on the removal of invasive plants known to alter soil chemistry. Periodic late summer visits to historic sites where the species location was precisely known could prove fruitful, and suitable habitats in the vicinity could also be searched for new populations.

Filling some of the voids in our knowledge about *Triphora trianthophoros* is an important step toward the development of meaningful management plans for the long-term persistence of the species. Research is needed in order to identify specific mycorrhizal associates, understand the timing and critical stages of seedling establishment, pinpoint the factors that trigger sexual reproduction efforts, and ascertain whether the species is threatened by belowground herbivory or competition.

Some attempts have been made to study the species' potential for offsite propagation and reintroduction but success so far has been minimal (Jones et al. 2016, Ramstetter in review). Consideration of augmentation or restoration as a management strategy for *T. trianthophoros* is premature due to gaps in our understanding of the species life history requirements. Nevertheless, investigation of the possibilities should continue in order to maintain options for the future.

Synonyms and Taxonomy

The accepted botanical name of the species is *Triphora trianthophoros* (Swartz) Rydberg. Orthographic variants, synonyms, and common names are listed below (ITIS 2021, USDA NRCS 2022, NAOCC 2022, POWO 2022, Britton and Brown 1913, Ramstetter 2001, Rhoads

and Block 2007, Weakley 2015). Some authors recognize two subspecies or varieties and the possibility of a third variety is still under evaluation, but only ssp./var. *trianthophoros* occurs in the northeastern U. S. (Medley 2020, Weakley 2015).

Botanical Synonyms

Triphora trianthophora (Sw.) Rydb.
Triphora trianthophora var. *schaffneri* Camp
Triphora pendula (Muhl. ex Willd.) Nuttall
Arethusa trianthophoros Sw.
Arethusa parviflora Michaux
Arethusa pendula Muhlenberg ex Willdenow
Pogonia pendula (Muhl. ex Willd.) Lindley
Pogonia trianthophoros (Sw.) Britton, Sterns & Poggenberg

Common Names

Three Birds Orchid
Threebirds
Nodding Pogonia
Nodding Ettercap

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