Before the Secretary of the Interior

Petition to list Great Lakes Jacob's Ladder (*Polemonium lacustre*) as a Threatened or Endangered Species Under the Endangered Species Act

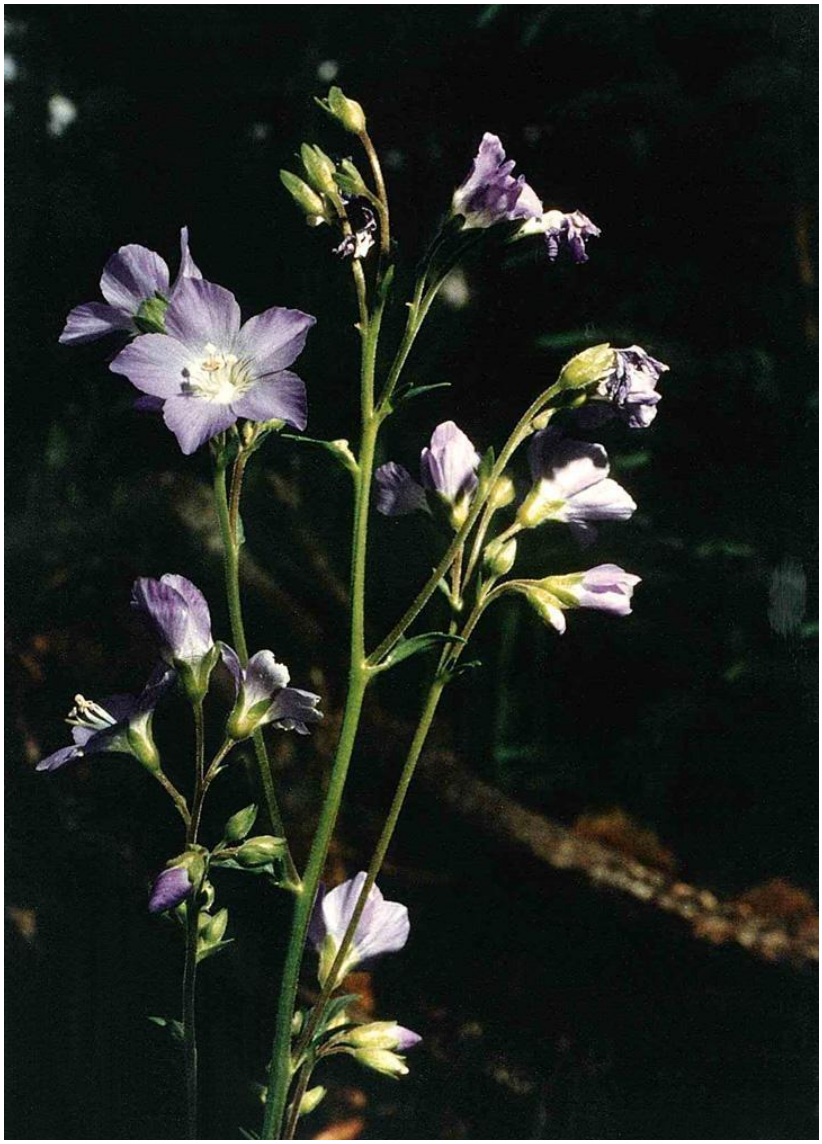

Photo by Stephen Solheim

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Notice of Petition

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Pursuant to Section 4(b) of the Endangered Species Act (ESA), 16 U.S.C. § 1533(b); section 553(e) of the Administrative Procedure Act (APA), 5 U.S.C. § 553€; and 50 C.F.R. § 424.14(a), the Botanical Club of Wisconsin and Minnesota Native Plant Society hereby petition the Secretary of the Interior, through the U.S. Fish and Wildlife Service (USFWS), to protect Great Lakes Jacob's ladder (*Polemonium lacustre*) as a threatened or endangered species under the ESA.
This petition requests listing of Great Lakes Jacob's ladder based on the extreme rarity of the species and recently observed declines.

The USFWS has jurisdiction over this petition. This petition sets in motion a specific process, placing definite response requirements on USFWS. USFWS must issue an initial finding as to whether the petition "presents substantial scientific or commercial information indicating that the petitioned action may be warranted." 16 U.S.C. § 1533(b)(3)(A). USFWS must make this initial finding "[t]o the maximum extent practicable, within 90 days after receiving the petition."

Submitted on May 10, 2024

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Executive Summary

Polemonium lacustre is a rare member of the phlox family that is endemic to the Upper Great Lakes. This taxon was formerly recognized as a subspecies of the western *Polemonium occidentale*, but recent research demonstrated enough genetic and morphological evidence to support elevation of *Polemonium occidentale* ssp. *lacustre* to full species status. Although seemingly suitable habitat–forested peatlands dominated by white cedar, black spruce, and tamarack–is not uncommon in the Great Lakes area, the species appears to thrive in heterogeneous stands that include small canopy openings. Numerous surveys for new populations have been conducted, but to date the species is found in only six sites across three counties in Wisconsin and Minnesota.

Populations of *Polemonium lacustre* have declined in the past few decades. One of the two Wisconsin populations has not been seen since the early 1990s despite multiple surveys, and large declines have been observed recently at two Minnesota sites, including the second largest site being reduced by 90%. The ecological requirements of *Polemonium lacustre* are poorly understood but potential threats include changes to natural hydrologic regimes, drastic reduction in canopy cover, and climate change. Although all six populations occur on public land, none are permanently protected from potentially incompatible land use such as road building or timber harvest. It is listed as endangered in Minnesota and Wisconsin and is on the US Forest Service Regional Sensitive Species List.

Introduction

Polemonium lacustre (Wherry) J. P. Rose & Sytsma is a perennial plant species found in northern Minnesota and Wisconsin highly reduced in range to just 6 known populations. The species appears to be a glacial relict, from a species that had previously been widespread across Canada (Rose and Sytsma, 2023, p. 33; Rose and Sytsma, 2022, p. 87). An obligate wetland species, the conifer swamp habitats where the species is currently found are typically disjunct from each other such that genetic exchange is unlikely, except perhaps between the two Wisconsin populations. Only one of the Wisconsin populations has been reconfirmed recently, with extensive searches at both historically known locations. Of the Minnesota populations, at least one is in severe decline, and another has also reduced in numbers.

The species' preferred location on these landscapes appears to be in canopy transition areas, where it produces flowers in openings and is generally vegetative under cover. Populations in steep decline, or potentially extirpated populations appear to be in areas where formerly open canopies have closed or, conversely, in areas where canopy had been completely removed at some point. It is likely that more restorative management may be needed in populations where the canopy heterogeneity has been lost and the canopy is closing, or has closed, or where canopy was completely removed. Threats to these populations include changes in hydrology that can affect water quality and canopy balance, including development, peat mining, beaver dams, and logging.

Natural History

Description

Polemonium lacustre (Wherry) J. P. Rose & Sytsma, until recently known as *Polemonium occidentale* ssp. *lacustre* (Wherry) Lakela, is an herbaceous perennial native to a restricted number of populations in northern Minnesota and Wisconsin. Originally described and discovered by Olga Lakela in 1944, the initial identified population was in St Louis County, in northern Minnesota (Anderson et al. 1998, p. 1).

From Lakela (1965, p.307):

> Plants up to 7 dm tall, rhizomatous, from slender caudices, glabrate below, pubescent above; lower leaves 1.5 dm long; petioles and rachis narrowly margined; leaves narrowly elliptic or linear, glabrous; floral bract pinnate, the

> uppermost reduced to a few segments; peduncles and pedicels densely viscid pubescent, calyx short-campanulate with obtuse deltoid lobes becoming longer than the tube, glabrate at tips, densely pubescent below; corolla violet blue, with spreading lobes; stamens included: filaments dilated, declined, hair-tufted below; ovary with nectar gland; style filamentous with ascending stigmatic lobes, violet or edge with violet. Rare; Extension of a Western species. Flowers June to July.

From Fernald (1950, p. 1186):

> Slender and horizontally creeping rhizome; summit of stem viscid and pilose but without elongate glands; leaflets lance-linear, 2-7 mm; the lowest bracteal leaf with 9-13 leaflets; panicle more branching and open, with long ascending branches; calyx-lobes deltoid-oblong to –lanceolate, acutish; corolla bright violet, strongly whitened at center. 1-1.5 cm high, Arbor-vitae swamp, St. Louis County, Minnesota. Flowers late June-early July – Eastern representative of a western species.

Taxonomy

The United States Department of Agriculture Plants Database lists 24 species in the genus *Polemonium* in the family Polemoniaceae in North America. This species is currently often still ascribed taxonomically as *Polemonium occidentale* ssp. *lacustre* (Wherry) Lakela.

Work by Rose and Sytsma (2023, p. 34-35) demonstrated enough genetic and morphological evidence to support elevation of *Polemonium occidentale* ssp. *lacustre* to full species status. The resultant *Polemonium lacustre* is likely a relic of a sister species to *Polemonium occidentale* that was prominent prior to previous glacial advances, occupying Canadian boreal forest wetlands. This document incorporates references to the now-outdated nomenclature, *Polemonium occidentale* ssp. *lacustre,* throughout the cited literature.

Life History

A likely long-lived perennial, the upper age limit of plants is unknown currently. Because the species has the capacity to reproduce both vegetatively and sexually, determining the age of a single ramet is difficult, but also perhaps irrelevant. Understanding the extent of vegetative vs. sexual reproduction, though, would be useful in interpreting spatial distribution patterns in surveys.

Plants typically flower from mid June to mid July, usually peaking around the first week in July. A single ramet appears to be able to produce multiple flowering stems, with multiple flowers per stem in a panicle inflorescence. Each flower produces a

single capsule that splits at the top when mature. The seeds are small and while not wind-born are likely small enough to be either lifted out of the capsule or be flung out when the capsule waves in the wind. Seeds are not likely to disperse far from the maternal plant, unless they land in water (Remucal, pers. comm.).

Habitat

Although generalization is difficult given the small number of known populations available, it appears that the species prefers conifer swamps with intermediate levels of disturbance. Canopy species include *Larix laricina*, *Thuja occidentalis* and *Picea mariana,* in openings or along edges the shrub layer is commonly dominated by *Betula pumila* and *Alnus incana*. The plant can reproduce vegetatively and through seed production. Most flowering, and therefore seed production, occurs under canopy openings, whereas plants that are under deep cover rarely flower (Anderson et al. 1998). *Polemonium* and other species show a negative relationship between sexual and asexual reproductive efforts (Obeso, 2002) showing some support for a hypothesized tradeoff between those two life history traits (Reznick, 1985). The flush of flowering evidenced with this and other species after a canopy is cleared can be temporarily beneficial to a population but result in a longer-term population loss if the landscape favors opportunistic seed recruitment rather than consistent recruitment which could certainly be the case in the landscapes *Polemonium lacustre* is found. In these cases, maintaining a heterogeneous canopy that has openings, either spatially or temporally, may be of the best long-term benefit to a population, allowing for sporadic seed production, while still allowing for consistent avenues for vegetative reproduction for population size maintenance.

In addition to the species preference for broken canopies or openings, it appears to prefer specific hydrological microhabitats. Although individual plants are often seen growing in sphagnum mats, they seem to prefer the hummocks of mats that are raised well above the water level, often concentrating around hummocks formed over tree roots, or stumps, or shrub or grass mounds.

The hydrological setting of documented populations suggests water comes from groundwater upwelling, making the habitat likely sensitive to changes in local groundwater levels and water quality (MN DNR, 2022).

Current and Historic Distribution

According to the Minnesota DNR (2022), the original described species collection occurred in 1944 by Olga Lakela in St. Louis County, Minnesota. A second collection in 1946 by “George Monson” (possibly mistranscribed name, likely this would be Lakela’s student Paul Monson) is documented in the herbarium records. The University of Minnesota Bell Herbarium does have two additional specimens collected in 1937 and 1944 by Lakela, but the species in both cases are listed as

Polemonium caeruleum ssp. *occidentale* (which would be highly disjunct from the Rocky Mountain range of this subspecies if true). One of these appears to be collected from the same location as the 1944 collection by Lakela of *Polemonium occidentale* ssp. *occidentale*, and the other (the 1937 specimen) from within Duluth, MN. These specimens would both need to be verified, but there has been no further record of *Polemonium lacustre* from Duluth.

The location record for the original 1944 specimen in inaccurate, though, as no individuals from that location later. From the 2003 conservation assessment of the species (Schmidt 2003, p. 10):

> Searches conducted during the 1960's and 1970's didn't reveal the documented population from the 1940's. The species was proposed for federal listing as Endangered by the late 1980's, thus prompting the Minnesota Natural Heritage and Nongame Research program to increase survey efforts.

During a search of 18 acres of appropriate locations around the original type location, Nancy Sather did find a population less than a mile from the collection location Lakela recorded in 1944 (Sather 1989, p. 8), and from discussion with researchers it appears likely that this population is the original source of the Lakela collection. (R. Holmgren, B. Carlson, C. Anderson pers. comm.)

Botanists found *Polemonium lacustre,* at the time considered a subspecies of *Polemonium occidentale*, in the Nicolet National Forest in 1982. From Schmidt (2003, p. 10):

> Initially, there was speculation about possible seed translocation to the Nicolet site from western populations of *Polemonium occidentale* v*. occidentale* via wildland firefighter's boots. This theory was dispelled in 1989 when samples were sent to Dr. Dieter Wilken, Director of Research Santa Barbara Botanic Garden, for verification. He affirmed the Minnesota and Wisconsin populations weren't differentiated, but the Midwest and the Western populations were.

Between 1992 and 1994, extensive ground searches were done in both Minnesota and Wisconsin (Anderson et al. 1998, p. 2). Prior to these searches there were 3 known populations in Minnesota and 1 in Wisconsin. In Minnesota 34 sites with favorable landscape conditions were searched, covering 4500 acres. In Wisconsin 39 sites were searched, covering 5800 acres. As a result of the search one new population was found in Wisconsin, close to the original Wisconsin site. A fourth Minnesota population was discovered in 2001 by Carlson during DNR survey work (B. Carlson and R. Holmgren, pers. comm.). The Minnesota populations are found in northeastern Minnesota and are multiple miles from each other, in Itasca and St. Louis Counties while the Wisconsin populations are in northern Wisconsin and are within a mile of each other, in the Chequamegon-Nicolet National Forest in Florence County. This is important as there is likely no genetic exchange between Minnesota

populations, as well as between the Minnesota and Wisconsin sites. Groundwork since these populations were identified has failed to identify any new populations in either state.

Conservation Status and Warranted ESA Protection

Polemonium lacustre is listed as endangered in both states where it occurs, though Wisconsin uses the name *Polemonium occidentale* ssp. *lacustre*. Both states also give it the subnational rank of S1, meaning it is critically imperiled. It is listed as a Regional Forester's Sensitive Species on the Chequamegon-Nicolet and Superior National Forests.

NatureServe, a network of over 60 organizations that collect and analyze data on rare species, has assessed the status of *Polemonium lacustre* across its entire range. This current assessment was done in 2014 when the taxon was still recognized as *Polemonium occidentale* ssp. *lacustre*, and at that time NatureServe assigned a global rank of G5?T2, meaning that *Polemonium occidentale* might be secure (G5?) but subspecies *lacustre* is imperiled (T2). Now that the taxon is recognized at the species level, Minnesota DNR botanist Derek Anderson has recently updated the G rank to G1G2, or critically imperiled-imperiled (D. Anderson pers. comm.). NatureServe global ranking will likely reflect that when updated.

As for federal listing, Schmidt (2003, p. 8) refers to the history of the listing decision for this species:

> Although the U.S. Fish and Wildlife Service placed the species under review in 1976 (as Federal Category 2), no formal action was taken due to the uncertainty surrounding the plant's taxonomic distinctness and the Category 2 status was removed (Anderson et al. 1998).

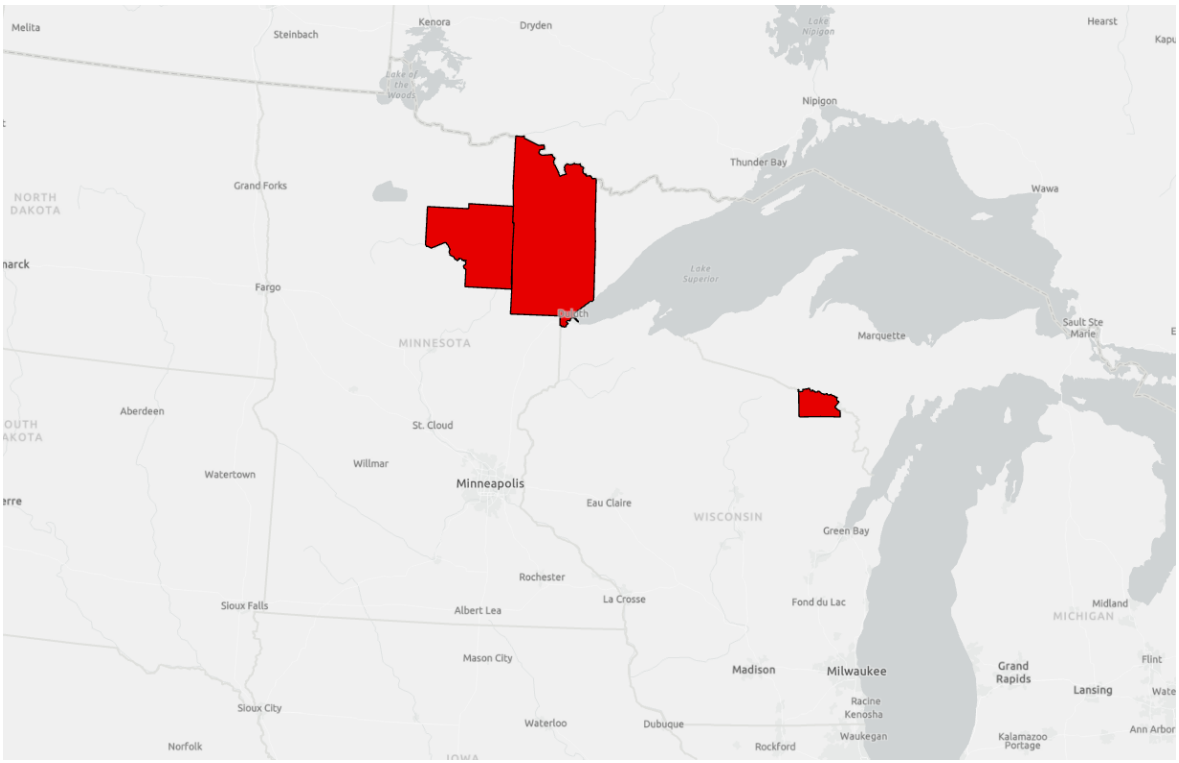

Figure 1. Map of counties where *Polemonium lacustre* occurs.

Population Size and Trends

As mentioned previously, there are six known populations of *Polemonium lacustre*. According to the NatureServe global rank assessment (NatureServe 2024), one Wisconsin population has not been seen since the early 1990s despite multiple survey attempts and may no longer be extant. Across the remaining five populations, there are between 2,500-10,000 individuals of *Polemonium lacustre* remaining. This range was used to capture the uncertainty of estimating genets in a species that often reproduces vegetatively. The number of genetically unique stems may be closer to 2,500 while the number of seed-producing stems may be closer to 10,000.

The NatureServe global rank assessment showed that there has been a 30-50% decline in the *Polemonium lacustre* population rangewide over the last 20 years. In Wisconsin, one population appears stable while in Minnesota, two populations have declined dramatically in the last 20 years, including the state's second largest population declining by 90%. There are currently only two populations, both in Minnesota, deemed to have good viability as ranked by heritage botanists (i.e., B ranked element occurrences) while one population in Wisconsin has good to fair estimated viability (BC ranked element occurrence).

Threats

Urban Development, Forest Management and Habitat Loss

Although *Polemonium lacustre* can be found under a range of canopy covers in the forested peatland, flowering, leaf numbers, and plant vigor are all positively correlated with small canopy openings (Anderson et al. 1998, p. 10; NatureServe 2024). Woody succession, therefore, may be an important threat. Historically, canopy openings were maintained through small natural disturbances such as windthrow, groundwater upwellings, small scale pest outbreaks (e.g., dwarf mistletoe) and anything else that created forest edges (Anderson et al. 1998, p. 13). It's likely, then, that the intensity, frequency, and areal extent of tree removal is important for long term viability at a given site.

Slash piles or log landings placed on top of plants and heavy machinery driven on unfrozen soil, all of which can be associated with large timber harvest operations, could destroy plants outright. The benefit to *Polemonium lacustre* from canopy openings may be short-lived, suggesting frequent disturbances are important. After a clear cut at a Minnesota site, for example, the number of plants and number of flowering plants initially increased, but over the next 30 years the population decreased dramatically within the harvested zone (C. Anderson pers comm.). It's possible, then, that this species requires a rotating patchwork of small canopy openings within the forested peatland matrix, a condition that is not often created or maintained by large scale timber harvests. It's also noteworthy that although all *Polemonium lacustre* sites have a history of logging, at three sites harvest occurred in strips, which created small openings and forest edges.

Based on the above information, certain types of timber harvest, particularly those that create large canopy openings which are then left to revegetated for decades, constitute a threat to *Polemonium lacustre*. Instead, restorative management, or small-scale tree removal which creates canopy openings periodically throughout the forest matrix and mimics small scale natural disturbances, may be appropriate.

Other Natural or Manmade Factors Affecting its Continued Existence

Any factors that could impact the natural hydrologic regime at the site are also considered a threat to *Polemonium lacustre*. This could include changes to offsite groundwater recharge areas that affect water quality and flow (e.g., addition of impervious surfaces in the recharge zone, groundwater extraction, etc.), flooding due to beaver activity, and altered surface water flow from nearby roads and trails. Beaver dam activity is currently impacting water levels at three of four sites in

Minnesota (R. Holmstrom pers. comm.). Large scale tree removal could also impact site hydrology if the water table increases substantially as less precipitation is intercepted by canopy trees and transpiration rates decrease. This, in turn, could impact habitat composition if certain tree species are unable to regenerate under the wetter conditions. Although the precise ecological requirements of *Polemonium lacustre* are not well understood, maintaining a heterogenous habitat that includes seepage upwellings, hummock-hollow microtopography, and occasional small canopy gaps is likely important. Since these habitat characteristics are all influenced by site hydrology, preserving intact hydrologic regimes is likely an important factor in this species' long-term viability.

Climate Change

Increased drought and flooding related to human-caused climate change is another threat facing *Polemonium lacustre* (NatureServe 2024). The Wisconsin Initiative on Climate Change Impacts (WICCI) rated cedar and tamarack swamps where *P. lacustre* grows as highly vulnerable to climate change due to their low adaptive capacity and greater dependence on stable water levels (Janowiak et al 2014, p. 92; WICCI 2020). In Wisconsin, impacts to hydrology have already been seen. 2018 and 2019 were two of the wettest years on record across northeastern Wisconsin (National Weather Service 2024), resulting in inundation of much of the habitat at one of the two known populations (D. Remucal pers. comm.). By July of 2023, over 95% of Florence County, where both Wisconsin populations occur, was in moderate drought. Failure of white cedar and tamarack, two tree species common in *Polemonium lacustre* habitat, to regenerate as temperatures warm and flooding and drought cause additional stress, will fundamentally change the ecosystem structure where *Polemonium* grows. The result of these changes is unknown but due to *Polemonium*'s extreme rarity, any changes to natural structure and/or processes is a major concern.

Disease or Predation

The forest pest emerald ash borer, which is already present in Wisconsin and Minnesota, is also a threat to *Polemonium lacustre*. Although the rarity of ash trees in this species' habitat makes direct impacts of emerald ash borer unlikely, there may be indirect impacts to *Polemonium lacustre* since black ash (*Fraxinus nigra*) can be common in adjacent stands within the larger wetland complex. If ash is lost from these adjacent forested wetlands, flooding could occur throughout the wetland complex as moisture that was held in the trees is released to the ground. If water levels rise enough, establishment of non-ash trees in *Polemonium* habitat could also be impeded and the community could convert from a forested stand to a more open sedge meadow or alder thicket.

The Inadequacy of Existing Regulatory Mechanisms

Although all *Polemonium lacustre* populations are located on county, state, or federal land, these sites are not formally and permanently protected from activities that are otherwise incompatible with Polemium viability, such as timber production. Both Wisconsin sites, for example, occur on the Chequamegon-Nicolet National Forest but are not within a research natural area, which the Forest Service designates to be permanently protected and maintained in natural condition. The largest population of *Polemonium lacustre* occurs on land owned by St. Louis County in Minnesota. The lack of permanent protection leaves this site open to the possibility, however remote, of being sold to an owner with no interest in preserving this species.

Research Needs

Since the factors affecting *Polemonium lacustre* viability are poorly understood and there are so few extant populations, it's hard to rank which threats are most pressing or predict population future population trends due to these threats. Perhaps the most pressing need for *Polemonium lacustre* is research. In particular, a better understanding of the intensity, frequency and scale of disturbances necessary to maintain viable populations of this species is critical. Such research may accompany canopy or shrub manipulation, with attention to location and season of work, equipment type and operation, and evaluation of results. This adaptive management approach would help land managers and conservation biologists carry out on the ground actions at *Polemonium* sites to stem the declines currently being observed.

The NatureServe global rank assessment of *Polemonium lacustre* highlights other important research needs:

> *Research into the life history of this species, including any observations relevant to its reproduction, survival, plant longevity, pollination and seed dispersal should also be conducted. Seed viability should also be tested as a potential cause of population declines in this isolated clonal species, and if low, determine if the cause is related to inbreeding, pollinators, or habitat degradation.*
>
> Ex situ *research related to germination, restoration techniques, and life history would also be beneficial to guiding future management decisions. With so few plants producing seed in Wisconsin, seed banking could safeguard against further losses, provide material for future outplanting efforts and an opportunity to study life history traits.*

Because the Wisconsin populations are under potentially immediate threat of extirpation, it would likely be beneficial, or even necessary to move some plants off-site while canopy management is done. Plants grown this way temporarily can be induced to flower and set seed, providing material for seed amplification for reintroduction to the original sites, and parent plants can also be reintroduced to the original locations after management activities. This research and work would improve our understanding of the restoration potential of this species, as well.

Conclusion

Polemonium lacustre is a rare species endemic to Minnesota and Wisconsin. Although the cedar-tamarack-black spruce swamps that it grows in are not rare, surveys throughout the region have revealed only six populations of the plant. Whether this extreme rarity is due to life history traits of the plant (e.g., poor dispersibility, low seed viability, etc.) or unique features of its habitat (i.e., a variety of microhabitats such as groundwater upwellings, hummock-hollow microtopography, and a rotating patchwork of small canopy openings within the forested matrix) is unknown.

More concerning than the species' rarity, however, are its population trends. One of the two Wisconsin populations has not been seen since the early 1990s despite multiple surveys, and large declines have been observed recently at two Minnesota sites, including the second largest site being reduced by 90% (NatureServe 2024).

The ecological requirements of *Polemonium lacustre* are poorly understood, making conservation and management recommendations difficult at this time. Potential threats include changes to natural hydrologic regimes, drastic reduction in canopy cover, and climate change. Until more research is conducted in the life history and factors regulating population establishment and growth the greatest care should be put into maintaining natural ecological processes at each site.

Although all six populations occur on public land, none are permanently protected from potentially incompatible land use such as road building or large-scale timber harvest. Protection of *Polemonium lacustre* under the US Endangered Species Act would provide direct protection for populations on national forest property (half of all populations) as well as attention and funding to examine critical questions about the species' life history and ecological requirements. Without this it's not guaranteed that existing resources will be sufficient to reverse the declines currently being observed across its range.

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