

*Conservation Assessment
for
Lance-leaved Violet (*Viola lanceolata* L. var. *lanceolata*)*



Photo by Scott A. Milburn

USDA Forest Service, Eastern Region
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Scott A. Milburn and Jason J. Husveth
Critical Connections Ecological Services, Inc.
14758 Ostlund Trail North
Marine on Saint Croix, Minnesota 55047



This Conservation Assessment was prepared to compile the published and unpublished information on the subject taxon or community; or this document was prepared by another organization and provides information to serve as a Conservation Assessment for the Eastern Region of the Forest Service. It does not represent a management decision by the U.S. Forest Service. Though the best scientific information available was used and subject experts were consulted in preparation of this document, it is expected that new information will arise. In the spirit of continuous learning and adaptive management, if you have information that will assist in conserving the subject taxon, please contact the Eastern Region of the Forest Service - Threatened and Endangered Species Program at 310 Wisconsin Avenue, Suite 580 Milwaukee, Wisconsin 53203.

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EXECUTIVE SUMMARY

This document serves to provide information pertaining to *Viola lanceolata* L. var. *lanceolata* (lance-leaved violet) for the purposes of developing conservation strategies to protect this species on United States National Forest System lands in the Lake States region. The Lake States National Forests include the Chequamegon-Nicolet, Chippewa, Hiawatha, Huron-Manistee, Ottawa, and the Superior. Of the six Lake States National Forests, the lance-leaved violet is listed as a Regional Forester's Sensitive Species (RFSS) and tracked in the Ottawa and Superior National Forests. The species is distributed within the Northeastern United States, the coastal states in the southern United States, the Appalachian region, the Great Lakes region including Northeastern Canada and the Pacific Coast.

As a member of the violet family (Violaceae), this species has characteristic zygomorphic flowers, a five-parted corolla, and a spurred anterior petal. The lance-leaved violet is a perennial species that appears stemless, although the stem is actually below ground. The narrow leaves are perhaps the key feature that field botanists use in confirming the identification of this species, and they are often three to six times longer than wide (Mohlenbrock 1978, Voss 1985, Gleason and Cronquist 1991).

This violet tends to inhabit saturated to wet habitats with sandy or organic substrates, including lakeshores, sedge meadows, and open bogs. These habitats typically experience some sort of disturbance event, which benefits this species due to its inability to compete with larger species. Lance-leaved violet is a pioneering species with an advantageous reproductive strategy that incorporates self-fertilization, cross-fertilization, and vegetative reproduction. As competition for light and nutrients increases within the community, the size of the population decreases, and the population waits for the next disturbance event. Following a disturbance event, the species is adapted to quickly germinate from the seed bank or colonize an open area vegetatively.

The greatest threat to lance-leaved violet is loss of habitat via development, but fire suppression, altered hydrology, and invasive species can also negatively affect this species. The lance-leaved violet is abundant in Michigan and Wisconsin, but is less common in Minnesota and is therefore designated as Threatened in the State. This status affords some protection, however agricultural lands, ditch systems, and roadway projects where the violet may also occur are exempt from the statute. On National Forest System lands, species identified as Regional Forester's Sensitive Species by the Forest Service are also protected. Proposed management activities on National Forest System lands in the near vicinity of a protected species are analyzed for potential effects and design criteria may be implemented to prevent or compensate for any adverse effects to that species.

There is little ongoing research for this species. However, there are several monitoring projects, which include the Ottawa National Forest and a wetland restoration site underway in Minnesota. Future research for this species should determine pollinators, seed bank viability and restoration approaches. Additionally, focused plant surveys for this species in appropriate habitats in national forest and other lands would be beneficial.

NOMENCLATURE AND TAXONOMY

Scientific name: *Viola lanceolata* L. var. *lanceolata*

Common names: Lance-leaved Violet, Water Violet (Ballard 1994), Bog White Violet (USDA Plants Database 2004), Strap-leaved Violet (Gleason and Cronquist 1991)

Family: Violaceae

Synonymy: *Viola lanceolata* L. spp. *lanceolata*

Taxon Code: VILAL (USDA Plants Database 2004); PDVIO040Y4 (NatureServe 2004)

Viola lanceolata L. var. *lanceolata* belongs to the violet family (*Violaceae*). Species within the family are distributed worldwide, with woody members generally in tropical regions and herbaceous members in temperate regions. The members of this family found on the North American continent tend to have zygomorphic flowers, with a five-parted corolla, the lowermost petal spurred. The family is comprised of two continental North American genera, *Hybanthus* and *Viola*. The genus *Viola* consists of herbaceous annuals or perennials (Zomlefer 1994), with stems either above or below ground, leaf variation based on attachment, margin, and shape, along with some species having both chasmogamous and cleistogamous flowers.

The lance-leaved violet belongs to the Section *Nominium*, Subsection *Plagiostigma*, and Group *Stolonosae*. There are seven violet species in the *Stolonosae* group, which is further divided into three subgroups *Palustres*, *Blandae*, and *Primulifoliae* (Russell 1955). Subgroup *Palustres* consists of two species, *V. epipsila* and *V. palustris*, both having blue flowers (Ballard 1994, Gleason and Cronquist 1991). Of these two species, only *V. epipsila* has been documented in the Lake States region (Ballard 1994). Subgroup *Blandae* includes only *V. blanda* and Subgroup *Primulifoliae* includes *V. macloskeyi*, *V. primulifolia*, *V. renifolia*, and *V. lanceolata* (Ballard 1994). All four of these species have been documented in the Lake States region (USDA Plants Database 2004).

In this Conservation Assessment, the biology, ecology, and taxonomy of *Viola lanceolata* L. var. *lanceolata*¹ are discussed. This variety is the only variety located within the Lake States region, being defined as Michigan, Minnesota, and Wisconsin. The two other varieties that occur in North America, *Viola lanceolata* L. var. *vittata* (Greene) Russell and *Viola lanceolata* L. var. *occidentalis* (Gray) Russell, are not described in detail for this assessment. *Viola lanceolata* L. var. *vittata* is distributed in the southeastern region of the United States and Russell (1965) indicated that the variety was also present in Michigan. The presence of *Viola lanceolata* L. var. *vittata* in Michigan has been questioned in the literature (Ballard 1994, Swink and Wilhelm 1979) based on review of herbaria records. Ballard (1994) concluded that the specimens that Russell identified as *Viola lanceolata* var. *vittata* in Michigan did not morphologically appear conclusively different from *Viola lanceolata* L. var. *lanceolata* to merit the identification as variety *vittata*. The third variety, *Viola lanceolata* L. var. *occidentalis*, is known only from

¹This document only specifically addresses *Viola lanceolata* L. var. *lanceolata*. When cited as *Viola lanceolata* throughout the text, assume the varietal status of *lanceolata*. Additionally, when the term "Species" is used in the text, this only refers to variety *lanceolata* unless otherwise stated.

Oregon and Washington. Due to insufficient evidence, there is still debate as to the correct taxonomic placement of variety *occidentalis* (Ballard, 2004, pers. corr.); this requires further investigation.

DESCRIPTION OF SPECIES

Viola lanceolata is a perennial species first described in North America in 1753 (Russell 1965). This violet's root system consists of slender roots, approximately 1 mm thick (Milburn pers. obs.), with many stolons that can be mat forming (Fernald 1950). The stem of the plant is found below ground, giving the appearance that the plant is stemless or acaulescent, ranging in height from 7 to 23 cm. As the colloquial name suggests, the leaves are lanceolate, approximately three to six times longer than wide (Mohlenbrock 1978, Voss 1985, Gleason and Cronquist 1991), and are glabrous to sparsely pubescent. The blades can measure up to 12 centimeters long and 2.5 centimeters wide (Mohlenbrock 1978). The margins of the blade vary from crenulate to serrate with reddish dots on the margins (Hill 1883). The reddish dots on the margins can be very useful in identifying this species when only the leaves are present.

The species has two types of flowers: chasmogamous (or petaliferous) and cleistogamous (small, self-pollinating flowers). The chasmogamous flowers have five white, beardless petals with pronounced purple veins mostly found on the anterior petal. The sepals associated with petaliferous flowers are glabrous and lanceolate (Gleason and Cronquist 1991). The cleistogamous flowers are found on short erect glabrous peduncles borne on the base of the primary root or the first node of the stolon (Fernald 1950). The chasmogamous flowers typically appear between May and July (personal observation) in this region (Michigan, Minnesota, and Wisconsin), but these flowers can bloom as late as mid-September in the Lake States (Husveth pers. obs., Trull, 2004, pers. corr.). The cleistogamous flowers can be present while the chasmogamous flowers are flowering, but tend to be prominent later in the growing season. The fruit capsules for both flower types are ellipsoid in shape and up to twelve millimeters long. The ripened seeds are obovoid in shape and olivaceous and are located in the three-parted capsule. Each seed capsule can produce up to one hundred and twenty seeds (Husveth pers. obs.).

The lance-leaved violet is distinguishable from other Lake States species in the *Stolonosae* group. The main morphological difference is the length of the leaf blade in comparison to the width, but flower color too can easily be used to identify as in the case of *V. epipsila* (blue flowered). The other white flowered violets in this group are likely to have leaf blades less than 1.5 times long as broad as indicated in Ballard's key (1994). *V. macloskeyi* has leaf blades that are cordate to orbicular, *V. renifolia* has leaf blades with truncate bases, *V. blanda* has leaf blades that are obtuse at the apex, and *V. primulifolia* has leaf blades that are ovate-subcordate to broadly elliptic.

LIFE HISTORY

Reproduction

The lanced-leaved violet has three reproductive strategies that include cross-fertilization, self-fertilization and clonal reproduction. This species has two different types of flowers (chasmogamous and cleistogamous), which rely on separate reproductive strategies (**Photo 1**). The chasmogamous or petaliferous flowers are cross pollinated, while cleistogamous flowers

resort to self-pollination (or “selfing”). The third strategy involves clonal (asexual) reproduction through the production of vegetative stolons.

Cross-fertilization occurs in association with the chasmogamous or petaliferous flowers by means of insect pollination. The exact pollinators for the lance-leaved violet are not documented in the literature, but we can generalize based on what is known about pollinators of other violets with similar floral morphologies. Prevalent insect pollinators for the genus *Viola* include bumblebees, midges, honeybees, solitary bees, hoverflies, and beeflies. The pollinators are initially attracted to the flower by means of the nectar guides, which are located on the anterior petals shown in **Photo 2**. The nectar guides serve to designate the path to the nectaries. As the pollinator approaches and lands on the anterior petal, one of two positions (prone and supine) can be utilized depending on the pollinator. In the prone position, the head and proboscis of the pollinator retain pollen grains while probing. Pollination then occurs when the pollinator either pollinates that flower (selfing) or when probing for nectar on a different individual. In the supine position, the pollinator lands in the same fashion, only to rotate upside down while probing. The pollinator while rotating retains pollen grains on the thorax in addition to the proboscis and head (Beattie 1971). The actual process of fertilization occurs as the pollinator inserts itself into the flower. As this is happening, the pollen on the pollinator is deposited on the stigmatic cavity, enabling the pollen to enter the style and ovary (Beattie 1974).

Cleistogamous flowers are morphologically different from chasmogamous flowers, described as being closed and having reduced petals (Mayers and Lord 1983, Nieuwland and Kaczmarek 1914). Although cleistogamous flowers are present throughout the growing season, cleistogamy tends to be the result of seasonal change. These self-fertilizing flowers are influenced by photoperiod and are more prevalent than chasmogamous flowers toward the latter portion of the growing season (Mayers and Lord 1983, Husveth, pers.obs.).

While the chasmogamous flowers stand erect above the ground, the cleistogamous flowers are either at the soil surface or just above. During the ripening process of the fruit, the capsule is propelled upright. In both floral types, the ripened fruit dehisces, resulting in the expulsion of the seeds into the air, with the greatest seed production in the cleistogamous flowers (Mohlenbrock 1978).

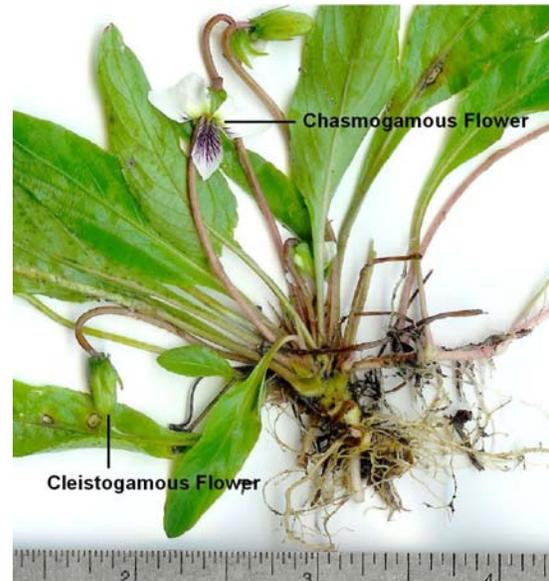


Photo 1. Cleistogamous (Fruiting) and Chasmogamous Flowers (Photo by Jason Husveth)

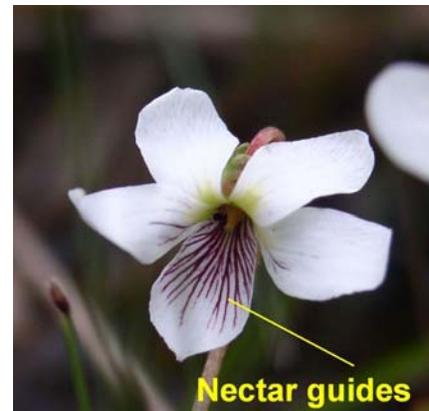


Photo 2. Nectar guides (Photo by Scott Milburn)

Vegetative reproduction is also a successful reproductive strategy. When there is a disturbance event resulting in the opening of bare ground, existing violet populations are readily able to colonize by means of stolon production. Stolons readily survive winter conditions (Solbrig et al. 1988) and are quite capable of quickly competing the next spring.

Ecology

Viola lanceolata inhabits plant communities that frequently experience some sort of disturbance event, either natural or anthropogenic. The species can be considered a pioneer species, quickly capitalizing on increased light, nutrients, and decreased competition. Following a disturbance event, which may include fire or inundation followed by drawdown (Keddy and Reznicek 1982), the viable seeds within the seed bank quickly germinate.

Once established, reproductive individuals replenish the seed bank. This species is very capable of proliferating when competition has been reduced or eliminated. As the individuals mature, the rate of seed production decreases (Solbrig et al. 1988) and competition from other species within the community increases. The increase in competition results in the reduced ability to obtain resources, resulting in a decline in the lance-leaved violet population. The population then awaits the next disturbance event to repeat this cycle.

Viola lanceolata hybridizes with *V. macloskeyi* (*V. lanceolata* x *macloskeyi*) and *V. blanda* (*V. lanceolata* x *blanda*). The hybrid with *V. macloskeyi* forms an intermediate offspring that is morphologically identical to *Viola primulifolia* (Russell 1954). Most of these hybridized populations are subfertile, but some individuals are capable of producing viable seeds via the cleistogamous flowers (Ballard 1994). There is still some debate regarding the actual status of this hybrid because some consider this a distinct species. Detection of a hybrid on a site is a good indicator that both parents are present nearby.

Dispersal

Seeds are generally dispersed in the immediate vicinity of the population. The seeds may remain where they land or may be transported by insects, mammals, waterfowl, or even water. The species is therefore capable of colonizing areas very distant from the initial seed source. This is suggested by the documentation of this species in South American (Ballard, 2004, pers. corr.).

Obligate Associations

The literature does not suggest that there are obligate associations for this species.

HABITAT

Range-wide

This species can be found growing on either sandy or organic substrates, in a variety of different habitats. These habitats range from sandy shores of water bodies or inundated basins, sandy borrow pits, sand flats, mud flats, rich and poor fens, sedge meadows, wet prairies, and open bogs (Ballard 1994) including commercial cranberry bogs (Russell 1965).

Lake States National Forests

Since this species is only designated as a RFSS on the Ottawa and Superior National Forests, the only detailed habitat information available for this species within the Lake States National Forest System is from these two forests. On the Ottawa National Forest, this species has been associated with sandy margins of inundated basins and lakeshores, roadside ditches, and sandy/boggy shores of water bodies. On the Superior National Forest, this species has been documented growing on sandy/gravel substrates on lakeshores. Documented associated species include *Agrostis scabra*, *Calamagrostis canadensis*, *Carex crawfordii*, *Carex lasiocarpa*, *Carex vesicaria*, *Chamaedaphne calyculata*, *Dulichium arundinaceum*, *Eriocaulon septangulare*, *Euthamia graminifolia*, *Gratiola aurea*, *Hydrocotyle americana*, *Iris versicolor*, *Lycopus americanus*, *Platanthera clavellata*, *Triadenum fraseri*, *Utricularia cornuta*, *Viola affinis*, and *Viola macloskeyi*.

Site Specific Habitat Information (Non-Forest Service Sites)

On the Anoka Sandplain, in the northern portion of the Minneapolis/Saint Paul metropolitan area of Minnesota, the lance-leaved violet is found growing in sedge meadows, wet prairies, rich fens, and poor fens. It is usually associated with loamy fine sands (**Photo 3**), but can also grow on shallow and deep mucky peats. In this region of Minnesota, this species is predominantly found

associating with *Agalinis purpurea*, *Agrostis hyemalis*, *Betula pumila*, *Calopogon tuberosus*, *Carex aurea*, *Carex lasiocarpa*, *Carex conoidea*, *Carex cryptolepis*, *Drosera intermedia*, *Fimbristylis autumnalis*, *Juncus marginatus*, *Liparis loeselii*, *Physocarpus opulifolius*, *Platanthera flava* var. *herbiola*, *Platanthera lacera*, *Polygala cruciata*, *Polygala sanguinea*, *Potentilla simplex*, *Scirpus cyperinus*, *Solidago graminifolia*, *Solidago uliginosa*, *Spirea alba*, *Spirea tomentosa*, *Triadenum fraseri*, *Utricularia cornuta*, and *Viola mackloski*, *Xyris torta* (Husveth 2003).



Photo 3. Habitat in the Anoka Sandplain of Minnesota
(Photo by Jason Husveth)

Within suitable habitats on the Anoka Sandplain, lance-leaved violet populations range from a few individuals over several acres, to one population comprised of well over one million plants (estimated by plot counts) throughout portions of a recently excavated five-acre wetland (Husveth, pers. obs., Husveth 2003). Populations of lance-leaved violet are most frequently associated with some form of intermediate disturbance to the perennial wetland vegetation and/or soil surface, both natural and anthropogenic. Examples of disturbance include: prescribed burns and wildfires, deer paths, human trails, tire treads, ATV disturbance, temporary flooding and drawdown of wooded wetland edges (and associated mortality of woody shrubs and trees), cultivation of wetland edges with agricultural machinery, excavation of stormwater ponds within effectively drained wetland areas, and site grading for residential and commercial developments.

Scarification of the soil surface and increased exposure to sunlight allow this species to germinate, flower, and sexually reproduce following disturbance events. In the absence of repeated disturbance (or management) these populations gradual reduce in numbers of reproductive individuals, and ultimately recede back into the seed bank. Based on these observations, the authors first focus aerial reconnaissance and field surveys within areas of recently disturbed native perennial vegetation when conducting surveys for lance-leaved violet within appropriate habitats on the Anoka Sandplain.

DISTRIBUTION AND ABUNDANCE

Range-wide Distribution

Viola lanceolata's (variety *lanceolata*) range-wide distribution includes the Northeastern United States, down the Atlantic and the Gulf Coasts into the Appalachian region, and over into the Great Lakes region including Canada (common in Central Ontario) and the Midwest (Gleason and Cronquist, 1991), in addition to the Pacific Coast (USDA Plants Database 2004). *Viola lanceolata* has been documented in thirty-three states (**Figure 1**), which include: Alabama, Arkansas, Connecticut, Delaware, Florida, Illinois, Indiana, Iowa, Kentucky, Maine, Maryland, Massachusetts, Michigan, Minnesota, Missouri, Nebraska, New Jersey, New Hampshire, New York, North Carolina, Ohio, Oklahoma, Oregon, Pennsylvania, Rhode Island, South Carolina, Tennessee, Texas, Vermont, Virginia, Washington, West Virginia, and Wisconsin (USDA Plants Database 2004). There is debate about whether the populations in Oregon and Washington are naturalized or native, but Ballard (2004, pers. corr.) believes these are native populations. The species has also been documented in six Canadian Provinces: British Columbia, New Brunswick, Newfoundland Island, Nova Scotia, Ontario, and Quebec (NatureServe 2004). This species has also been documented in northern Venezuela and Columbia, which is thought to have established via seed translocation from North America by migratory waterfowl (Ballard, 2004, pers. corr.).



Figure 1. Distribution in the Continental United States and Canada.

State and National Forest Distribution

As noted above, this variety is documented in the Lake States Region, Minnesota, Wisconsin, and Michigan (see also **Figure 2**). Distribution of *Viola lanceolata* in Michigan includes most of the counties in the Upper Peninsula, with populations documented in the northern and western counties of the Lower Peninsula (USDA Plants Database 2004). The species is on the edge of its range in Minnesota, having been documented in ten eastern counties to date (J.F. Bell Museum of Natural History, University of Minnesota Herbarium 2004). It is mostly distributed in the Anoka Sandplain north of the Minneapolis/St. Paul metropolitan region. The populations in the Anoka Sandplain can vary between just a few individuals to dense mats of an acre or greater with several hundred thousand individuals (Young 1875, Husveth and Milburn pers. obs.). Distribution in Wisconsin is fairly common with documented populations throughout the western and northern portions of the state (Robert W. Freckmann Herbarium, University of Wisconsin – Stevens Point 2004).

The lance-leaved violet has been documented in five of the six Lake States National Forests within Region 9. These include the Chequamegon-Nicolet, Hiawatha, Huron-Manistee, Ottawa, and the Superior National Forests (**Table 1**). Of these National Forests with documented populations, only the Ottawa and Superior National Forests track their known populations due to its RFSS designation. The designation as “Sensitive” is based on the criteria described in the Forest Service Manual (2670.44) and the designation as such is the responsibility of each Regional Forester.

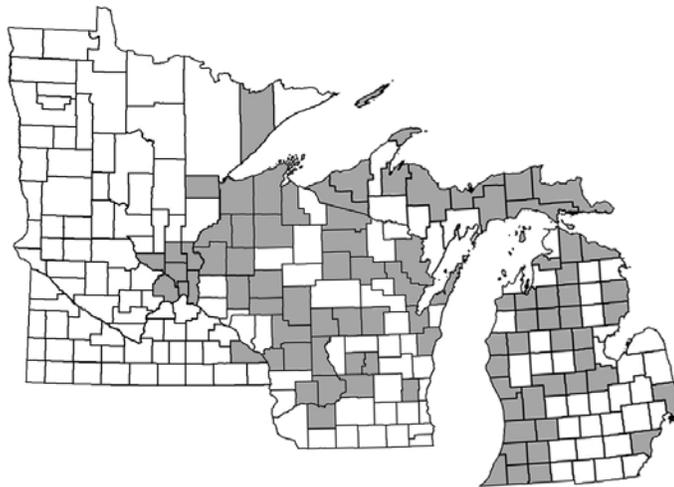


Figure 2. County Distributions of *Viola lanceolata* within Minnesota, Wisconsin, and Michigan.

The species has also been documented in two non-Lake States Forests in Region 9; Green Mountain and Hoosier National Forests in Indiana. This violet has not been identified as a Regional Forester’s Sensitive Species in either forest.

There are four locations on the Ottawa National Forest with documented populations of lance-leaved violet. Of these populations, the number of individuals ranged between one hundred to over one thousand individuals per population. There are two documented populations located in the Boundary Waters Canoe Area Wilderness within the Superior National Forest. Both documented populations had over one hundred individuals recorded, and have not been revisited since the initial discovery.

Table 1. Status of *Viola lanceolata* in the Lake States National Forests

National Forest	Present	Tracked	RFSS
Chequamegon-Nicolet	Yes	No	No
Chippewa	No	No	No
Hiawatha	Yes	No	No
Huron-Manistee	Yes	No	No
Ottawa	Yes	Yes	Yes
Superior	Yes	Yes	Yes

RANGE WIDE STATUS

In reviewing the status of *Viola lanceolata*, the species is not listed as threatened or endangered by the U.S. Fish and Wildlife Service (Endangered Species Program), and is listed as threatened in Minnesota (Minnesota Department of Natural Resources) and Vermont (Vermont Department of Fish and Wildlife), Special Concern in Iowa (Iowa Threatened and Endangered Species Protection Program), and Potentially Threatened in Ohio (Ohio Natural Heritage Program).

NatureServe (2004) provides conservation status information pertaining to the species and all three varieties. The species, *Viola lanceolata* L. (Heritage Identifier: PDVIO040Y0), is common

throughout its range (G5) and is common in the United States (N5) and Canada (N5). It is identified as critically imperiled (S1) in Nebraska and Vermont, imperiled (S2) in Iowa and Minnesota, vulnerable (S3) in Ohio, and apparently secure (S4) in Kentucky, North Carolina, and West Virginia. In the Canadian provinces, the species is identified as critically imperiled in Prince Edward Island, between critically imperiled and imperiled (S1S2) in Newfoundland Island, apparently secure (S4) in Ontario, and secure (S5) in Nova Scotia.

Variety *lanceolata* (Heritage Identifier: PDVIO040Y4) is common throughout its global range (G5T5) and is common in Canada (N5) and the United States (N5). The populations in Columbia and Venezuela do not appear to be recognized by NatureServe (2004), and therefore do not have a ranking to date. The variety *lanceolata* is ranked as apparently secure (S4) in West Virginia and common (S5) in Delaware, New Jersey, and Nova Scotia. The other states and provinces are currently unranked.

NatureServe Definitions

Definition of G5: Secure – Common, widespread, and abundant (although it may be rare in parts of its range, particularly on the periphery). Not vulnerable in most of its range. Typically with considerably more than 100 occurrences and more than 10,000 individuals.

Definition of T5: Secure - Subspecies, varieties, and populations common, widespread, and abundant (although it may be rare in parts of its range, particularly on the periphery). Not vulnerable in most of its range. Typically with considerably more than 100 occurrences and more than 10,000 individuals.

Definition of N5: Secure - Common, widespread, and abundant in the nation or state/province.

States & Provinces: (S-rank is for each *subnational* jurisdiction in its range)

S1: Critically imperiled because of extreme rarity (5 or fewer occurrences or very few remaining individuals or acres) or because of some factor(s) making it especially vulnerable to extirpation from the subnation.

S2: Imperiled because of rarity (6-20 occurrences or few remaining individuals or acres) or because of some factor(s) making it very vulnerable to extirpation from the subnation.

S3: Vulnerable in the subnation either because rare and uncommon, or found only in a restricted range (even if abundant at some locations), or because of other factors making it vulnerable to extirpation. Typically 21 to 100 occurrences.

S4: Apparently secure, uncommon but not rare, and usually widespread in the subnation. Possible cause for long-term concern. Usually more than 100 occurrences and more than 10,000 individuals.

S5: Secure, common, widespread, and abundant in the subnation. Essentially ineradicable under present conditions. Typically with considerably more than 100 occurrences and more than 10,000 individuals.

S?: Rank not yet assessed. Unlikely that it is tracked by the Natural Heritage Program.

SR: Reported to occur in the subnation but without a basis for either accepting or rejecting the report, or the report not yet reviewed locally. Some of these are very recent discoveries for which the program hasn't yet received first-hand information: others are old, obscure reports.

SNR: Not ranked or currently under review.

POPULATION BIOLOGY AND VIABILITY

Viola lanceolata has evolved to thrive after a disturbance event as a pioneering species. These disturbance events can include the removal of vegetation by means of fire, animal trails, vehicles, fluctuating water levels from year to year or ice scour (Trull, 2004, pers. corr.). The overall strategy of this species is to generate and disperse enough seed when competition within the community is reduced. As the number of individuals within the population itself grows, seed production is reduced. As the successional processes proceed within the community, competition increases and the size of the population is reduced. Due to the small size of this violet, it is at a disadvantage in its ability to compete for sunlight with larger plant species. A lack of disturbance enables larger herbaceous species and shrubs to migrate into those areas where the population is located. The ability to produce a large amount of seed enables the species to remain in the seed bank and wait for the next disturbance event to repeat the process again.

The species is able to reproduce by means of selfing, crossing, and clonal reproduction. Species in the genus are recognized as producing more seed through the process of selfing, but the literature does not specify for the lance-leaved violet. Additionally, the literature does not indicate how long the seed bank remains viable. Within likely habitats, the seed bank in peat soils may persist for years, while seed banks in sandy shores may be less persistent due to removal of seed from wave action. Seed banks associated with sandy shores are additionally more likely to be exposed to extreme conditions of freezing and drying.

POTENTIAL THREATS

Present or Threatened Risks to Habitat

The greatest threat to this species is the loss of habitat due to development. This is especially true along lakeshores throughout the Lake States and the wetlands in the Anoka Sandplain region. Direct destruction of habitat and alteration of surrounding landscapes can lead to changes in regional hydrology and natural fire regimes, and to increased competition from non-native invasive vegetation. Such alterations can disrupt natural disturbance events, and interrupt the cycle of succession that this species has evolved with. Yet the pioneering tendency of this species can also enable it to benefit from certain anthropogenic activities, which can include manipulated habitats (commercial cranberry bogs, borrow pits, ATV trails, and ditches).

Along lakeshores, development can either directly or indirectly impact populations. The complete development of lakeshore property can result in the loss of existing habitat, while indirect impacts such as reduction in hydrologic draw-down interfere with the natural disturbance regimes and establishment of seasonal ephemeral habitats. Populations on private or public beaches are also subject to mechanical removal (rototilling) or chemical treatment (herbicide) in an attempt to have beach property void of vegetation (Trull, 2004, pers. corr.). The two documented populations on the Superior National Forest are located on islands used for camping, but the populations appear safe from impacts.

In the Minneapolis/St. Paul metropolitan region in Minnesota, development is the prevalent threat to the species. The forecasted growth rate is expected to increase by one million people by the year 2030 (Metropolitan Council 2004), promoting development and alteration to the

landscape. Much of this development is occurring in the Anoka Sandplain region, just north of Minneapolis and Saint Paul, where most of the state's lance-leaved populations have been documented. Populations in this region were thought to be significantly reduced due to agriculture and development, with the fate of this species in this region in jeopardy (Coffin and Pfannmuller 1988). With the species at the edge of its range, as is the case in Minnesota, populations on the periphery are more susceptible to extinction, but tend to be more diverse genetically. Fortunately, recent detailed botanical surveys in this region completed by the authors have documented over one hundred new populations of the species. Throughout the Lake States, the threat to this species is still present due to habitat loss, changing landscapes, climatic changes, increased competition from invasive species, and succession without disturbance.

Over utilization

This species is not used for medicinal or other commercial uses.

Disease or Predation

The literature does not allude to problems with either disease or herbivory.

Inadequacy of Existing Regulatory Mechanisms

Of the three Lake States, this species is least common in Minnesota and it is protected through the Endangered Species Statute (Section 84.0895), with it listed as Threatened in Minnesota. The Minnesota Department of Natural Resources is responsible for administering the statute, which restricts activities that result in the taking, importing, transporting, or selling of protected species. However, activities on agricultural lands, ditch systems, and roadway projects are exempt from the statute. Additionally, use of herbicide on agricultural lands is allowed under the statute, as long as care is taken to prevent impact to adjacent lands where protected populations are known to exist.

Other Natural or Human Factors

In addition to habitat loss through development, another activity that threatens this species is the unregulated use of all-terrain vehicles (ATVs). ATV activity can have both positive and negative impacts on existing populations of the lance-leaved violet. ATV activity often has negative impacts through trampling and loss of vegetation, erosion, changes to soil characteristics and water regimes at the microsite scale the violet inhabits. ATV use is only beneficial when it mimics natural disturbance, which in turn reduces plant competition and exposes the viable seed bank (Husveth, pers. obs). The negative impacts usually outweigh any benefit and



Photo 4. Example of damage caused in potential lance-leaved violet habitat by ATV traffic. (Photo by Steven Spickerman)

should not be considered as a management strategy. ATV traffic can lead to severe habitat degradation, which has been documented on the Chequamegon-Nicolet National Forest (**Photo 4**). Continuous ATV activity can destroy existing populations, thereby preventing regeneration of the seed bank as well as preventing vegetative reproduction. ATV activity also has the potential to promote the dispersal of noxious/aggressive weeds such as *Phalaris arundinacea* (reed canary grass) and *Lythrum salicaria* (purple loosestrife), which can use the same habitat as the violet.

SUMMARY OF LAND OWNERSHIP & EXISTING HABITAT PROTECTION

As noted previously, this species has been documented on five of the six Lake States National Forests. Since it is fairly common in the Lake States, it can be found on both public and private lands.

PROTECTION

On a federal level, *Viola lanceolata* is protected on the Ottawa and Superior National Forests, and thus subject to management policies requiring that these forests:

- Assist States in achieving their goals for conservation of endemic species.
- Review programs and activities, through a biological evaluation, to determine their potential effect on sensitive species, as part of the National Environmental Policy Act process.
- Avoid or minimize impacts to species whose viability has been identified as a concern.
- Analyze the significance of potential adverse effects on the population or its habitat within the area of concern and on the species as a whole, if impacts cannot be avoided. (The line officer, with project approval authority, makes the decision to allow or disallow impact, but the decision must not result in loss of species viability or create significant trends toward Federal listing.)
- Establish management objectives in cooperation with the States when projects on National Forest System lands may have a significant effect on sensitive species population numbers or distributions. Establish objectives for Federal candidate species, in cooperation with the FWS or NMFS and the States (FSM 2670.3).

Of the three Lake States, this species is sufficiently uncommon to have been protected in Minnesota by state law where it has Threatened status (Minnesota Department of Natural Resources). A species is designated as Threatened when that “species is considered threatened if the species is likely to become endangered within the foreseeable future throughout all or a significant portion of its range within Minnesota” (Minnesota Department of Natural Resources).

SUMMARY OF EXISTING MANAGEMENT ACTIVITIES

Botanists from the Ottawa National Forests revisited two sites that had been documented in the past by collections submitted to a university herbarium. One additional site with a population of *Viola lanceolata* was discovered during summer project surveys (Trull, 2004, pers. corr.). These sites are currently being monitored.

PAST AND CURRENT CONSERVATION ACTIVITIES

Rescued violets have been transplanted at one of the four sites on the Ottawa National Forest, and Forest Service botanists have started a monitoring study at this location.

RESEARCH AND MONITORING

Existing Surveys, Monitoring, and Research

The Ottawa and Superior National Forests are the only Forests in the Lake States to track the lance-leaved violet. Botanists at the Ottawa National Forest are currently planning to collect plant composition data at a site with *Viola lanceolata*. The area is a swimming beach, maintained by the district. District staff has been rototilling the beach to keep it free of vegetation. Ottawa National Forest Botanists have set up a study where half of the beach would be left unmanaged and the other half would continue to be rototilled. Plant composition data would be collected for a period of time and this information would be used in future management efforts. Additionally, a portion of the population in the area that is being rototilled was transplanted to the unmanaged half, and this will also be monitored. The populations on the Superior National Forest have not been visited since the initial discovery in 1992.

In addition to monitoring on federal lands, there is a habitat restoration and monitoring project currently underway (by the authors) in the Anoka Sandplain region in Minnesota. This is a restoration of a wet meadow/rich fen, in an area that has been designated as a city park in Blaine, Anoka County, Minnesota. The restoration site has seven state listed species including *Viola lanceolata*. The park is surrounded by development and has not been exposed to a natural fire regime for many years. As a result, the site has become overgrown by native perennial and shrubby vegetation, as well as aggressive invasive species. The current restoration approach has included manual removal of shrubby vegetation and removal of the shrub roots within heavily-degraded areas, and manual raking of leaf duff near the edges of existing rare species populations to foster the local expansion of rare species populations. This removal of shallow perennial root-mass exposes the underlying organic peat and native seed bank. The conclusion thus far after two years restoration and monitoring data is that the historic seed bank is viable and diverse. Within areas that were scraped down 3 to 6 centimeters to organic peat, *Viola lanceolata* and *Fimbristylis autumnalis* have been two of the primary species to emerge from the seed bank and flower in the first season. Future restoration activities on this site will include the aggressive management of invasive species through chemical means along the restoration site periphery, and reintroduction of fire to 14 acres of the system. The site has permanent monitoring plots that are surveyed twice during the growing season.

Survey Protocol

Existing populations on the Superior National Forest should be revisited every few years. There should be additional efforts to find undocumented populations, focusing on shallow open water bodies with fluctuating water levels or sandy wetlands. The authors have developed remote sensing protocols for the Anoka Sandplain of Minnesota that are based primarily on the analysis of digital soil surveys within a geographic information system (GIS). Optimal soil associations and soil catenas are located at a county or city wide scale (i.e. thirty to several hundred square miles), and optimal soil associations and soil patterns are identified and compared with recent

aerial photographs. Sites are then prioritized for a detailed field survey in early spring based on aerial photography signatures (i.e. native vegetation, associated species, hydrology), land ownership and access, and land use history. Using this survey approach, the authors have located over 100 new occurrences of *Viola lanceolata* within central Minnesota between 1997 and 2004. Several of these populations represent range extensions within Minnesota and county record collections. This method relies heavily on the compilation and analysis of existing known populations and associations with soil, surficial geology, hydrology, and associated plant species, and the spatial locations of historic and new records. As new populations are located, a thorough list of associate species should be compiled along with environmental and phenology data, and these data used to refine and strengthen the remote survey methods and field survey protocols (Husveth 2003).

Research Priorities

Future research should attempt to add to the basic understanding of this species, locate new populations on Federal lands, and develop restoration and management methods to protect existing populations. Since *Viola lanceolata* is not documented on the Chippewa National Forest, efforts should be made to locate potential habitat and survey these habitats. Moreover, additional populations may occur on the Ottawa and Superior National Forests and inventory should continue.

In reviewing the available literature, questions remain unanswered relating to general ecology and population biology. Solbrig et al. (1988) attempted to address the population biology of this species, but the information provided pertaining to *Viola lanceolata* is fairly limited. There should be renewed effort in the scientific community to determine the role of the seed bank, rate of germination, seedling survival and fecundity rates of *Viola lanceolata*.

Finally, restoration and management methods should be developed to protect existing populations of lance-leaved violets. Methods should be designed to mimic natural disturbance events. It is important to note that restoration activities that prevent lance-leaved violet from reseeding should not be implemented. Management should reduce inter-species competition, enabling the violet populations to thrive and reinvest in the seed bank.

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APPENDIX: National Forest *Viola lanceolata* Sites

Forest	County	Habitat	Abundance	Comments	Protected?
Ottawa	Gogebic	Shoreline of lake, 12-16" from water's edge on moss mat. Sandy-mucky.	500+		Yes
	Gogebic	On sandy beach of oligotrophic lake.	135+	Part of habitat is managed as swimming beach. Administrative study beginning to monitor population while rototilling/mowing continues on part of beach habitat and other part is left undisturbed.	Partial
	Ontonagon/ Houghton	Outer, upper margins of several seasonally inundated basins on sandy soils.	1000+		Yes
	Ontonagon	In wet drainage ditches along both sides of paved road in sandy area.	500+		Not particularly; may fall within county road right-of-way
Superior					
	Lake	Flat, open bedrock - cobble/gravel beach area.	100's	Gravel beach area with no overstory, shrub layer is very light with willows and ash.	In the BWCA Wilderness.
	Lake	Gravel-sand-cobble beach area.	100+	Area is open sand/gravel with no overstory and the shrub layer is very light.	In the BWCA Wilderness.

LIST OF CONTACTS

Information Requests

Dr. John Almendinger, Forest Ecologist, Minnesota Department of Natural Resources,
john.almendinger@dnr.state.mn.us

Dr. Harvey E. Ballard, Jr., Associate Professor, Plant Systematics & Evolution Department of
Environmental & Plant Ohio University, ballardh@ohio.edu

Alix Cleveland, Forest Plant Ecologist, Huron-Manistee National Forest, acleveland@fs.fed.us

Bonita Eliason, NHNRP Program Supervisor, Minnesota Department of Natural Resources,
bonita.eliason@dnr.state.mn.us

Lynden Gerdes, MCBS Botanist/Plant Ecologist, Minnesota Department of Natural Resources,
lynden.gerdes@dnr.state.mn.us

Jack Greenlee, Forest Plant Ecologist, Superior National Forest, jackgreenlee@fs.fed.us

Dr. Emmet J. Judziewicz, Assistant Professor of Biology, Curator of Vascular Plants, Robert W.
Freckmann Herbarium, Department of Biology, University of Wisconsin Stevens Point,
ejudziew@uwsp.edu

Mike Lee, MCBS Botanist/Plant Ecologist, Minnesota Department of Natural Resources,
michael.lee@dnr.state.mn.us

Deborah Lewis, Curator of the Ada Hayden Herbarium, Iowa State University,
dlewis@iastate.edu

Ray Newman, Forest Plant Ecologist, Chippewa National Forest, rwnewman@fs.fed.us

Linda Parker, Forest Ecologist, Chequamegon- Nicolet National Forest, lrparker@fs.fed.us

Dr. Anthony Reznicek, Curator of Vascular Plants University Herbarium (University of
Michigan), Dept. of Ecology and Evolutionary Biology, reznicek@umich.edu

Jan Schultz, Forest Plant Ecologist, Hiawatha National Forest, jschultz@fs.fed.us

Steven Spickerman, Plant Ecologist, Chequamegon- Nicolet National Forest,
sspickerman@fs.fed.us

Welby Smith, NHNRP Botanist, Minnesota Department of Natural Resources,
welby.smith@dnr.state.mn.us

Hannah (Dunevitz) Texler, NHNRP Regional Plant Ecologist, Minnesota Department of Natural
Resources, hannah.texler@dnr.state.mn.us

Sue Trull, Forest Botanist, Ottawa National Forest, strull@fs.fed.us

Review Requests

Marjy Brzeskiewicz, Plant Ecologist, Chequamegon- Nicolet National Forest,
mbrzeskiewicz@fs.fed.us

Alix Cleveland, Forest Plant Ecologist, Huron-Manistee National Forest, acleveland@fs.fed.us

Jack Greenlee, Forest Plant Ecologist, Superior National Forest, jackgreenlee@fs.fed.us

Ray Newman, Forest Plant Ecologist, Chippewa National Forest, rwnewman@fs.fed.us

Linda Parker, Forest Ecologist, Chequamegon- Nicolet National Forest, lrparker@fs.fed.us

Jan Schultz, Forest Plant Ecologist, Hiawatha National Forest, jschultz@fs.fed.us

Sue Trull, Forest Botanist, Ottawa National Forest, strull@fs.fed.us