

The Conservation Status of *Trillium* in North America

Clayton Meredith, Anne Frances, Amy Highland, Leah Oliver, Aaron Floden, L.L. Gaddy,
Wesley Knapp, Danna Leaman, Susan Leopold, Tara Littlefield, Robert Raguso,
Edward Schilling, Alfred Schotz, Anna Walker, and Kjirsten Wayman





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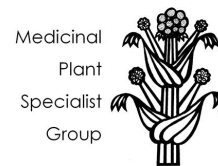


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Back: *Pseudotrillium rivale* (K. Wayman)

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Dedication

This report is dedicated to the memory of Tom Patrick, a foremost expert on *Trillium* in the southeastern United States. He was a student of the genus for more than 40 years. It began in the 1970s with his graduate work on *Trillium* [*Trillidium*] *grandiflorum*, his description of *T. sulcatum*, and continued while as a botanist with the Georgia Natural Heritage Program and included advancements in the life history of *T. reliquum*, assistance in describing recent species such as *T. oostingii* and *T. delicatum*, and supporting other researchers studying this complex genus. In addition to his work on *Trillium*, he was the first botanist in the Georgia Department of Natural Resources, authored *Protected Plants of Georgia*, a widely cited botanical reference, won the Georgia Plant Conservation Alliance lifetime achievement award, and was respected and admired within the botanical community.

Contents

Acknowledgements	4
Funding	4
Dedication	4
Foreword	7
Executive Summary	8
Methodology	10
Taxonomy	10
Data Collection and Quality Control.....	10
Mapping	11
Results and Evaluation	12
Major Threats	14
The <i>Trillium</i> Collections at Mt. Cuba Center	16
A note on the taxonomy of <i>Trillium</i>	17
On western <i>Trillium</i>	19
Floral scent, taxonomy, and ecology of <i>Trillium</i> in North America	20
History of Medicinal Use	22
Information on the trade	22
Ending the <i>Trillium</i> Trade in Commercial Herbal Products	23
Species Assessments	24
<i>Pseudotrillium rivale</i>	25
<i>Trillidium undulatum</i>	25
<i>Trillium albidum</i>	26
<i>Trillium albidum</i> subsp. <i>albidum</i>	26
<i>Trillium albidum</i> subsp. <i>parviflorum</i>	27
<i>Trillium angustipetalum</i>	27
<i>Trillium catesbaei</i>	28
<i>Trillium cernuum</i>	28
<i>Trillium chloropetalum</i>	29
<i>Trillium cuneatum</i>	29
<i>Trillium decipiens</i>	30
<i>Trillium decumbens</i>	30
<i>Trillium delicatum</i>	31
<i>Trillium discolor</i>	31
<i>Trillium erectum</i>	32
<i>Trillium flexipes</i>	32
<i>Trillium foetidissimum</i>	33
<i>Trillium georgianum</i>	33
<i>Trillium gracile</i>	34
<i>Trillium grandiflorum</i>	34
<i>Trillium kurabayashii</i>	35
<i>Trillium lancifolium</i>	35
<i>Trillium ludovicianum</i>	36
<i>Trillium luteum</i>	36
<i>Trillium maculatum</i>	37
<i>Trillium nivale</i>	37
<i>Trillium oostingii</i>	38
<i>Trillium ovatum</i>	38
<i>Trillium crassifolium</i>	40

<i>Trillium hibbersonii</i>	40
<i>Trillium ovatum</i> var. <i>oettingeri</i>	41
<i>Trillium ovatum</i> var. <i>ovatum</i>	41
<i>Trillium scouleri</i>	42
<i>Trillium persistens</i>	42
<i>Trillium petiolatum</i>	43
<i>Trillium pusillum</i>	43
<i>Trillium pusillum</i> var. <i>monticulum</i>	45
<i>Trillium pusillum</i> var. <i>virginianum</i>	45
<i>Trillium pusillum</i> var. 4.....	46
<i>Trillium pusillum</i> var. 5.....	46
<i>Trillium pusillum</i> var. <i>ozarkanum</i>	47
<i>Trillium pusillum</i> var. 1.....	47
<i>Trillium pusillum</i> var. <i>pusillum</i>	48
<i>Trillium pusillum</i> var. 3.....	48
<i>Trillium recurvatum</i>	49
<i>Trillium reliquum</i>	49
<i>Trillium rugelii</i>	50
<i>Trillium sessile</i>	50
<i>Trillium simile</i>	51
<i>Trillium stamineum</i>	51
<i>Trillium sulcatum</i>	52
<i>Trillium tennesseeense</i>	52
<i>Trillium texanum</i>	53
<i>Trillium underwoodii</i>	53
<i>Trillium vaseyi</i>	54
<i>Trillium viride</i>	54
<i>Trillium viridescens</i>	55
Photos	56
Works Cited	67
Appendix A: All Red List Category and Criteria Designations	80
Appendix B: All NatureServe Rankings	82
Appendix C: Red List Categories and Criteria	84
Appendix D: Table of Common Names Used in Text	85

Foreword

The transfixing beauty of *Trillium* belies their structural simplicity. These ephemeral woodland wildflowers, composed of three petals and three bracts, possess unique charm that has beguiled naturalists, collectors, and gardeners for generations. Encountered in the wild, *Trillium* catch the eye and imbue their habitat with an air of specialness, as if you have stumbled into a magical forest. *Trillium* also possess medicinal value, as an astringent and uterine stimulant, giving rise to the common name 'birthwort.' Under pressure from habitat loss, White-tailed Deer browse, climate change, and plundering, many *Trillium* are becoming less prevalent in the wild.

And so it is with many plants of medicinal value. The Medicinal Plant Specialist Group of the International Union for the Conservation of Nature's Species Survival Commission estimates that there are around 2,000 plant species native to North America that are used medicinally. The Medicinal Plant Specialist Group is charged with filling information gaps to accurately assess the conservation status of these species, identify habitats critical to their survival, and recommend management strategies to improve their prospects for the long-term.

Convened under the auspices of the Medicinal Plant Specialist Group and the North American Plant Red List Authority of IUCN, this project brought together the botanical expertise of many of North America's foremost *Trillium* researchers. Partner organizations including the New Mexico BioPark Society, NatureServe, and Mt. Cuba Center, made this collaboration possible.

Clay Meredith, Species Survival Officer for Plants, at New Mexico BioPark Society organized the conservation status assessments, the results of which inform this overall assessment of *Trillium*. A weeklong workshop at Mt. Cuba Center leveraged the field knowledge and analytical proficiency of fifteen North American plant scientists to review the findings and bring this assessment to fruition.

Given the uncertain and evolving conservation status of several *Trillium* species, this assessment is critical and timely. The results provide up-to-date information to guide the efforts of ecologists and restoration professionals, and to better understand the gaps in our understanding that remain to be investigated. This survey highlights the importance of ongoing fieldwork on North American medicinal plants and reaffirms the urgency of efforts to ensure their safe keeping. Thanks to all those who helped in this important effort.

Jeff Downing
Executive Director
Mt. Cuba Center

Executive Summary

The genus *Trillium* is made up of about 50 species worldwide with concentrations in eastern and western North America and eastern Asia. The diversity of *Trillium* in North America warrants special recognition because both the Pacific Northwest and the eastern half of the United States are centers of endemism for the genus¹. Identifying the conservation needs of the genus is a high priority given recent taxonomic changes within the family, the number of species with small ranges which could be conserved through relatively minor interventions, and the need for coordinating action between a variety of conservation organizations. Assessment of the conservation status of *Trillium* is considered here to be a first step in the development of comprehensive conservation action plans for under-conserved members of the genus.

Trillium, also known as Wake-robin or Toadshade, are wildflowers that are found in a variety of woodland habitats. They are long-lived perennial plants and are often slow to reach flowering age. Flowers are produced in March – June, though some species along the Gulf Coast flower as early as January, and some at high altitude in the west flower as late as July. Fruiting takes place in summer, and seeds from many species are dispersed by ants which are attracted to a highly nutritious appendage on the seed called an elaiosome². Other important shared life history traits include floral self-incompatibility, and complex seed dormancy. The taxonomy of this genus is complex, but ongoing research is answering long-standing questions and revealing diversity in some species complexes. *Trillium* was formerly included in the family Liliaceae, however, it is sometimes placed in Trilliaceae³⁻⁵ or Melanthiaceae^{6, 7}. The genus is split into two informal groupings that divide those species that have stalked flowers, the Pedicellate *Trillium*, and those species with flowers that have no stalk and are attached directly to the stem, the Sessile *Trillium*. Historically, a narrow definition of species concepts was accepted. Through the course of the 20th century, however, many of these names were relegated to synonymy¹⁻³. Recent molecular evidence has resurrected several of these taxa and raised questions about whether other species might represent complexes of cryptic species. This evidence also suggests that two taxa traditionally accepted as members of *Trillium* are more accurately treated as forming the closely related but genetically distinct genus *Trillidium*. Throughout this booklet, the most current taxonomic interpretations are presented. Future taxonomic changes will likely alter some of the information presented here, but the authors have taken care to present several possible outcomes. Colloquially, the grouping of members of the genera *Pseudotrillium*, *Trillidium*, and *Trillium* have been referred to as “*Trillium*”. Due to the recency of taxonomic changes and the familiarity many have with this terminology, this volume will frequently refer to all three genera in the aggregate as *Trillium* unless specific distinctions are needed.

Regions with the greatest richness of threatened *Trillium* taxa follow the trend of general species richness, but one area stands out in this regard. The southeastern United States is home to the greatest number of threatened species. This reflects the unique evolutionary history of the region, which served as a glacial refugium and consequently hosts many localized endemic species. The Pacific Northwest also hosts a significant number of threatened taxa, and recent genetic evidence has revealed previously unrecognized taxonomic diversity. Again, localized endemics in the region are the major contributing factor. Other regions hosting threatened species include the Sabine River basin and surrounding areas of Texas and Louisiana, and portions of the Mid-Atlantic extending from Raleigh to the Delmarva Peninsula. The latter is driven by the *Trillium pusillum* complex which is increasingly recognized as a diverse taxonomic grouping containing several threatened taxa. Using the narrowest plausible taxonomic interpretation, 32% of *Trillium* taxa are listed under a threatened category on the IUCN Red List of Threatened Species. NatureServe’s rankings resulted in 51% of *Trillium* taxa in North America in the Imperiled to Vulnerable categories. The discrepancy is due to NatureServe’s recognition of varieties and subspecies in some species which inherently increases the likelihood of detection of rarity.

Threats identified in this analysis are quite varied. While threats broadly follow trends based on species range and biology, the slow life history and poor seed dispersal of the group make all taxa susceptible to some degree to population declines. Habitat damage caused by feral Pigs and predation due to the overabundance of White-tailed Deer threaten more taxa than any other factors. Other threats include competition with introduced plant species, habitat loss due to development, overcollection for medicinal or horticultural purposes, and climate change. Unfortunately, the quality of data supporting each of these threats is inconsistent. For example, while some introduced plant species are often cited as major competitors, namely Kudzu (*Pueraria montana*) and Japanese Honeysuckle (*Lonicera japonica*), both species may have paradoxical impacts through complex interactions with White-tailed Deer behavior. Data are also lacking for the impact of collection for medicinal or horticultural purposes. While anecdotal reports of collection for medicinal purposes abound, and a market clearly exists, few data exist regarding which species are harvested, and how collection impacts wild populations. Even instances where threats are supported by a much larger body of literature issues of scale, and the rapid pace of population changes, complicate application of available data at the regional or continental scale. Targeted research is needed to better understand these threats on a scale appropriate to species conservation.



1788 illustration of *Trillium sessile* by Sydenham Edwards. Originally published in *The Botanical Magazine* volume 2.

Methodology

A variety of tools are available for evaluating extinction risk to plants. In North America, NatureServe's global ranking system is the most widely used. Elsewhere in the world, the IUCN Red List's method is more commonly used. These complementary species ranking methodologies were used to create conservation status assessments for North American *Trillium* species in 2019 and 2020, and were reviewed by an expert panel in a workshop at Mt. Cuba Center in October of 2019. The methodologies utilize the same underlying concepts and information, or "factors", namely species' rarity, threats, and population trends, however each evaluates the data differently. NatureServe's method follows a weight-of-evidence approach, while the IUCN Red List's method applies a series of rules, each with minimum criteria that must be met. NatureServe's method places a greater emphasis on rarity, while trend data carry a stronger weight in the Red List methodology's measure of extinction risk⁸. Figure 1 shows the comparable categories between the NatureServe and Red List extinction risk categories. Methods employed by both systems are briefly discussed below. For a detailed description of the thresholds used by NatureServe and the Red List, consult NatureServe Conservation Status Assessments: Methodology for Assigning Ranks⁹ and the IUCN Red List Categories and Criteria: version 3.1¹⁰. Throughout this text, terminology borrowed from both organizations will be used. Subpopulations are defined according to the IUCN Red List's definition of a group which exchanges fewer than one gamete per year with other groups. For *Trillium*, this is roughly synonymous with NatureServe's definition for element occurrences indicating that a subpopulation occurs at least one km from another.

Taxonomy

The taxa list for this evaluation was compiled by comparing Flora of North America¹¹, NatureServe¹², and the USDA PLANTS Database¹³. Considerable taxonomic uncertainty remains within the genus *Trillium*, and some species are recognized without having been uniformly accepted by authorities. Where such disagreements occur, attempts were made to assess species complexes as a whole, and under more narrowed taxonomic interpretations. The taxa presented here reflect a conservative approach based on the consensus of the 2019 *Trillium* Working Group. Taxa which have the potential to be elevated to the species level, even those which have not been validly published, were considered within Red List assessments for validly published species under which they are currently recognized. These are presented separately in this volume, not as a proposed revision of the taxonomy, but to ensure that revisions of the taxonomy can be rapidly accounted for in conservation assessments. As many of these proposed species have

highly restricted ranges, it is of critical importance to consider the conservation status of these populations, even prior to a universally accepted taxonomic structure. Regardless of the direction taxonomic revision takes, efforts should be taken to maintain genetic diversity within accepted species and the morphological and genetic outliers presented here will remain of conservation concern.

Currently accepted terminology is used where such terminology is not disputed. For species without validly published scientific names, but that are regionally recognized based on their distribution and habitat differences, variety numbers are used. These numbers were chosen to be consistent with Alan Weakley's treatment of the genus¹⁴. *Trillium pusillum* var. 2 is notably missing as this variety has been subsequently elevated to the species level (*Trillium georgianum*) and is now broadly accepted.

Data Collection and Quality Control

The best available information on all known, described species of North American *Trillium* species (and putative species) was first collated and used to develop distribution maps. Data were compiled using IUCN's Species Information Service (SIS), a web-based database for storing and managing IUCN conservation assessments. Relying on data describing the species' range, population, habitats, and ecology, uses, threats, current conservation measures, and other factors, conservation assessments were conducted following the IUCN Red List of Threatened Species Categories and Criteria version 3.1¹⁰. Relevant data for assessments was gathered from a variety of sources including herbarium specimens, published and unpublished literature, Botanic Gardens Conservation International's database of specimens¹⁵, national and regional floras, and consultation with numerous experts.

Using this information, each species was assigned to one of the eight Red List conservation categories: Extinct (EX), Extinct in the Wild (EW), Critically Endangered (CR), Endangered (EN), Vulnerable (VU), Near Threatened (NT), Least Concern (LC), or Data Deficient (DD). CR, EN, and VU are considered "threatened" categories (Figure 1 and Appendix C). For further information on assessment methods, consult the IUCN Red List Categories and Criteria¹⁰ and the Guidelines for Using the IUCN Red List Categories and Criteria¹⁶.

Conservation status assessments using NatureServe's methodology which analyzes rarity, threats and trends⁹, were also conducted on all North American *Trillium*. NatureServe's Conservation Status Ranks are nested in three

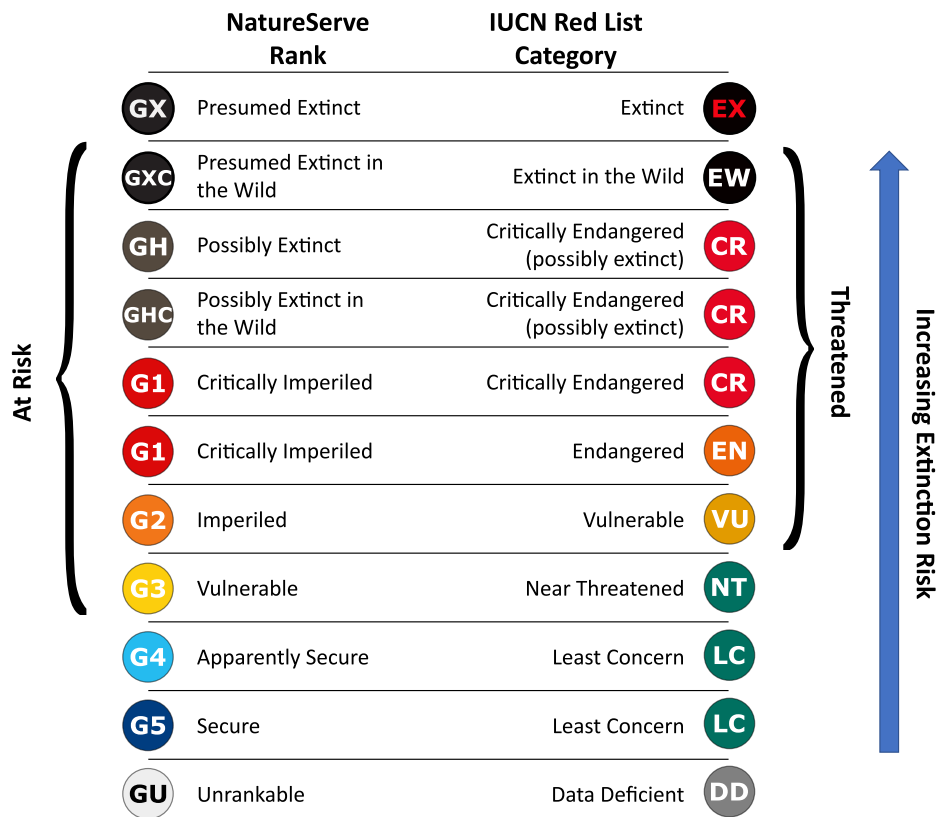


Figure 1: Comparison of NatureServe Ranks and IUCN Red List Categories.

geographic scales: Global (G), National (N) and Subnational (S) (i.e. state and provincial). Subnational level data for all *Trillium* were gathered from NatureServe’s Network programs through a shared and distributed database, *Biotics*. These Subnational conservation status ranks and their related spatial data that detail the location, landscape condition and viability of each occurrence of the species in the jurisdiction, give a snapshot of the species’ extinction risk in each state or province. After the Subnational data were reviewed, primary and secondary literature were analyzed for data and information pertaining to species’ Global imperilment as outlined in Faber-Langendoen *et al.*⁹. The resulting Conservation Status Ranks Critically Imperiled (G1) to Secure (G5) (see Figure 1 for details). Conservation status ranks beginning with ‘T’ indicate a Global rank for a variety or subspecies, and should be preceded by the rank for the species, e.g. G4T1. In cases where there are multiple varieties or subspecies, the T ranks will sum to the species’ Global rank. Two additional global ranks, GX (Presumed Extinct) and GH (Possibly Extinct) are also used, and qualifiers “Q” and “C” are used when there is questionable taxonomy or when a species is presumed extinct but extant in cultivation, respectively.

The resulting Red List and NatureServe assessments were reviewed by the *Trillium* Working Group 2019 at a workshop hosted by Mt. Cuba Center in October 2019.

Mapping

Using ArcMap 10.3.1¹⁸, taxa were mapped following the IUCN Mapping Standards and Data Quality guidelines¹⁹. It is critical to note that these guidelines are intended to incorporate the totality of a taxon’s natural range and maps may include large tracts of unsuitable habitat. Herbarium specimens and research grade observations from a variety of sources were used to inform the range polygons. Point data used to inform the polygon ranges presented in this volume are available for download along with the individual species assessments for each species at iucnredlist.org²⁰. In addition to credible point data, published range maps were considered along with textual descriptions of species ranges. In some cases, the results follow biogeographic borders, in others, arbitrary lines following county or state boundaries are considered. The most up to date information was incorporated in each range map, and maps were subsequently reviewed and edited based on the authors’ expertise.

Results and Evaluation

The product of this effort is the first comprehensive conservation assessment of all North American species in the genus *Trillium*. Results of conservation assessments vary based on which taxonomic structure is considered valid. A comparison is made here between only those taxa which are validly published at the species level (Table 1, and Figure 2) and those that are considered by the authors to be most likely to be valid (Table 1, and Figure 3). Of the 53 North American *Trillium* taxa considered (using the narrowest taxonomic treatment for each taxon), 17 fall into a threatened category, 4 are listed as Near Threatened, and 27 are listed as Least Concern. Five taxa lacked sufficient information to assign to a category and are listed as Data

Deficient. Criterion B (based on restricted geographic range of a taxon) was the most commonly used of the listing criteria (Table 3). Note that because multiple criteria may be used to list a species under a threatened category, the total number of taxa listed in all criteria is not consistent with the total number of threatened taxa.

Results are similar for the accepted species, with slightly fewer taxa falling into threatened categories. The primary driver of this difference is the large number of taxa which could be listed as threatened within the *Trillium ovatum* and *Trillium pusillum* complexes.

Red List Category	Number of Taxa (Possible Future Taxonomy)	Number of Taxa (Accepted Species)
Extinct	0	0
Extinct in the Wild	0	0
Critically Endangered	3	1
Endangered	4	3
Vulnerable	10	6
Near Threatened	4	4
Least Concern	27	23
Data Deficient	5	3
Total	53	40

Table 1: Results of Red List assessment under different taxonomic interpretations.

NatureServe Rank	All Taxa	Accepted Species
Presumed Extinct	0	0
Possibly Extinct	0	0
Critically Imperiled	7	6
Imperiled	3	2
Vulnerable	14	11
Apparently Secure	18	17
Secure	7	7
Unranked	8	4
Total	57	47

Table 2: Results of NatureServe ranking at different taxonomic levels. The All Taxa column refers to the taxa with assessments in this booklet, some of which are provisional taxa. These taxa are indicated by a dagger symbol in the assessments. Accepted Species refers to those that are formally published and available on NatureServe Explore.

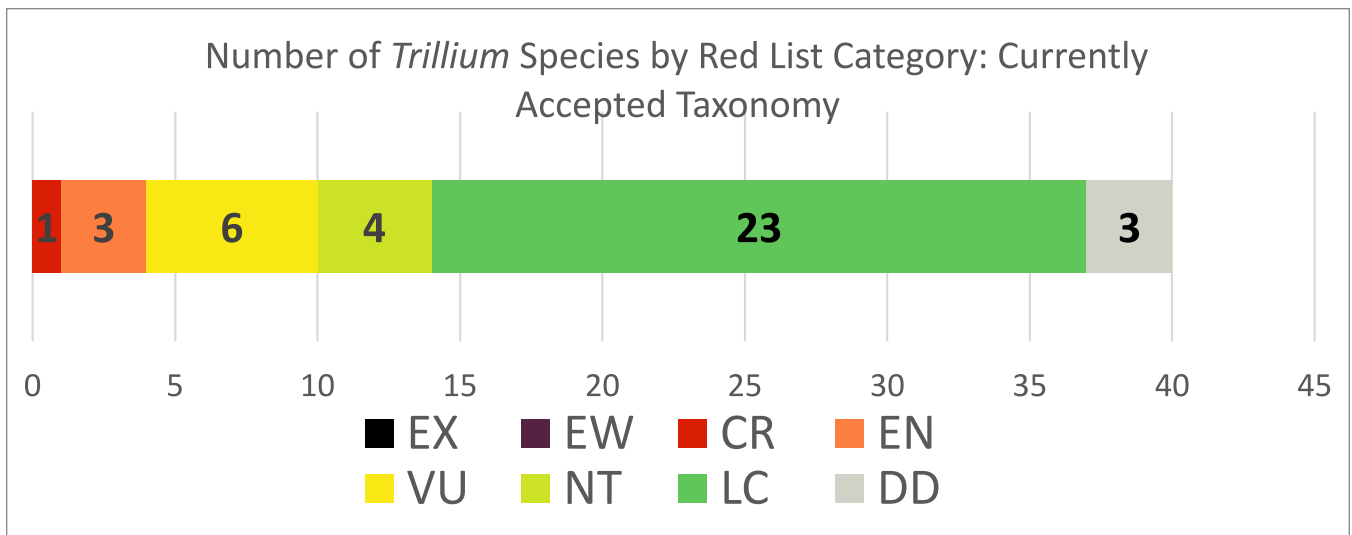


Figure 2: Number of taxa listed under each category using the broadest consideration of taxa within the genus *Trillium*.

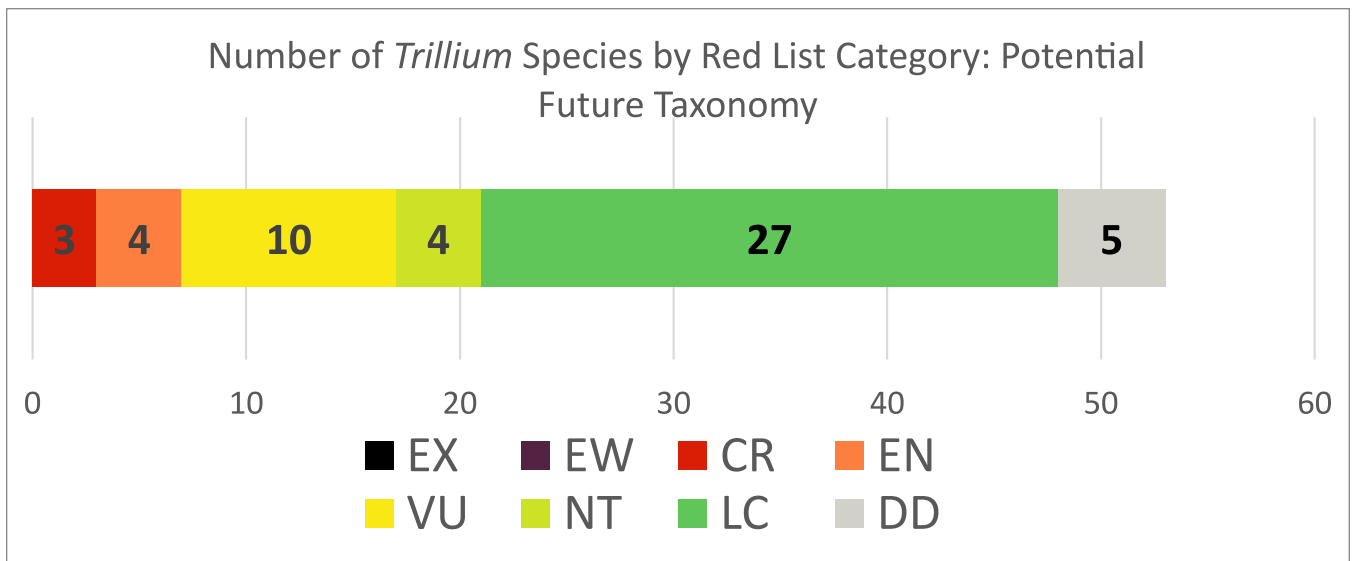


Figure 3: Number of taxa listed under each category using the most likely taxonomic outcomes.

Red List Category	Number of Taxa	Percent of Threatened Taxa
A	0	0%
B	13	76%
C	1	6%
D	4	24%
E	0	0%
Total	18	106%

Table 3: Number of threatened species listed under each IUCN Criterion following the most likely taxonomic structure.

Major Threats

Clayton Meredith, New Mexico BioPark Society

The most common threats to North American *Trillium* species are outlined in Figure 4. Threats were coded using the IUCN classification scheme^{16, 21}. Invasive non-native species and problematic native species are a threat to the largest number of taxa regardless of their extinction risk. Of these threats, overabundance of White-tailed Deer (39 taxa threatened), and rooting by feral Pigs (34 taxa threatened) are the largest contributors. The threat posed by both species is very widespread and has been intensively studied²²⁻³⁵.

The White-tailed Deer population in eastern portions of North America expanded dramatically through the 20th century, reaching densities that are greater than have occurred for thousands of years²³. The causes of White-tailed Deer overabundance are numerous, but significant factors include the widespread extirpation of large carnivores including Gray Wolves (*Canis lupus*) and Cougars (*Puma concolor*), reduced hunting pressure, and increased carrying capacities resulting from landscape alteration and fragmentation of forest habitats. Extensive documentation exists demonstrating *Trillium* population declines resulting from herbivory by White-tailed Deer. So well studied is this relationship, that *T. grandiflorum* and *T. erectum* are widely used as indicators of herbivory pressure^{22, 24, 25}. The impact of White-tailed Deer predation varies according to characteristics of individual species with those that bloom earlier in the season, are taller, or have showy, sweet-smelling flowers being the most at risk of predation.

Management of White-tailed Deer populations and analysis of their impact is an extremely complex set of problems on an ecological, political, logistical, and social level. Monitoring must consider complex relationships between overabundant White-tailed Deer, and other processes. For example, the impacts of White-tailed Deer herbivory and collection of some species for horticultural or medicinal purposes has been demonstrated to have population impacts which are non-additive through the masking effect of browsing³⁶. This is likely also the case for *Trillium* species which can undergo reversible stage class transitions, and should be a consideration when developing monitoring strategies. White-tailed Deer overabundance is an intractable long-term problem with few viable solutions and with impacts that are likely to persist long after White-tailed Deer populations are brought down to historic levels³⁷. The political dynamics of managing increasingly fragmented habitats which lack apex predators are not likely to be solved in the foreseeable future, and the need for innovative solutions is dire.

Habitat disturbance caused by feral Pigs primarily threatens

Trillium species in the southern United States, though the increasing spread of feral Pigs northward and westward suggests it is likely to become a threat to more species in the foreseeable future³³. Damage caused by feral Pigs is especially concerning surrounding the Chesapeake Bay where several *Trillium* taxa with small ranges occur and where Pigs have not yet been reported but models suggest habitat is favorable³³.

However, the impact of rooting feral Pigs is context specific and may impact habitats in disparate ways. Wetland habitats may benefit from disturbance caused by Pigs and may experience increased species richness following disturbance events³⁵. Such benefits are likely to impact short-lived species rather than long-lived rhizomatous species like those in the genus *Trillium*. Upland areas, steep slopes, and areas with rocky substrates also provide some level of protection against disturbance caused by rooting. This leads to variation in the potential impact of Pigs on a taxonomic basis. In general, the sessile *Trillium* occur in low-lying areas and are less impacted by periodic disturbance. However, these areas are at greatest risk of substantial modification due to rooting activity and the sessile *Trillium* are generally considered to be subject to the greatest risk from feral Pigs.

Both feral Pigs and overabundant White-tailed Deer compound the impacts of other invasive species and can contribute to broader habitat modifications which may result in reduced biodiversity^{34, 38, 39}. Habitat modification can extend to the loss of favorable soil conditions through decreases in carbon to nitrogen ratios and loss of leaf litter³⁴. The cumulative impact of disturbance caused by feral Pigs is likely to extend far beyond the immediate impacts causing direct mortality.

Non-native competing plants also impact many *Trillium* species. Though Japanese Honeysuckle (*Lonicera japonica*) and Kudzu (*Pueraria montana*) are widely cited as major threats to *Trillium* species, it is unlikely that either species causes significant population declines. Kudzu may have paradoxically beneficial impacts for *Trillium* through the deterrence of White-tailed Deer, and through enriching soils with nitrogen while leaving out after most *Trillium* species have bloomed. The most impactful competing species, and those most likely to continue displacing *Trillium* species, are those that cause long-term habitat modifications and alter successional stages. Foremost among these are Chinese Privet (*Ligustrum sinense*), Bush Honeysuckle (*Lonicera maackii*), and Garlic Mustard (*Alliaria petiolata*), each of which forms dense stands which impede successional

stages and directly impact herbaceous understory species. Burning Bush (*Euonymus alatus*), English Ivy (*Hedera helix*), Japanese Stiltgrass (*Microstegium vimineum*), Silverberry (*Elaeagnus commutata*), Trifoliolate Orange (*Poncirus trifoliata*), and Winter Creeper (*Euonymus fortunei*) are among the other non-native plants which compete with or exclude *Trillium* species. An invasive insect, the Hemlock Woody Adelgid (*Adelges tsugae*), threatens two species as it can impact the forest composition upon which the species are dependent.

Other threats include habitat loss due to development for residential or commercial purposes, silvicultural practices, and mining. Much of the genus' diversity is concentrated in the southeastern United States, a region projected to experience extremely rapid expansion of urban areas into adjacent forested areas in the coming decades⁴⁰. Collection for medicinal and horticultural purposes is a poorly documented threat which may have significant impacts on several species. Medicinal collections are geographically focused in the Appalachian Mountains and impacts to species in this area are expected to be locally severe⁴¹. Horticultural collections are expected to be most severe for rare species which are intrinsically susceptible to population declines and more highly valued on horticultural markets.

Threats to western *Trillium* species differ dramatically from those in eastern North America. The taxonomy of western *Trillium* species is not well settled, and many of the taxa of greatest conservation need are recently described local or regional endemics, which are inherently susceptible to stochastic events and localized threats. Because of this, relatively low intensity threats may have disproportionately large impacts that are poorly understood relative to their eastern counterparts. The greatest threats to western *Trillium* species arise due to habitat modifications associated with logging, residential development, and alteration of natural fire regimes. In each case, these threats vary in intensity regionally. Logging poses serious threats to *Trillium* species in Oregon⁴², though these have declined in intensity in recent decades. Residential development is an acute threat surrounding rapidly expanding cities in the Puget Trough⁴³, and the San Francisco Bay Area. Altered fire regimes are presently considered to be the most significant threat to western *Trillium* species and the negative impact caused by fire is expected to grow because of climate change in the region⁴⁴. As with eastern species, competing invasive plant species may contribute to habitat quality declines. Himalayan Blackberry (*Rubus armeniacus*) is considered the most significant non-native competitor.

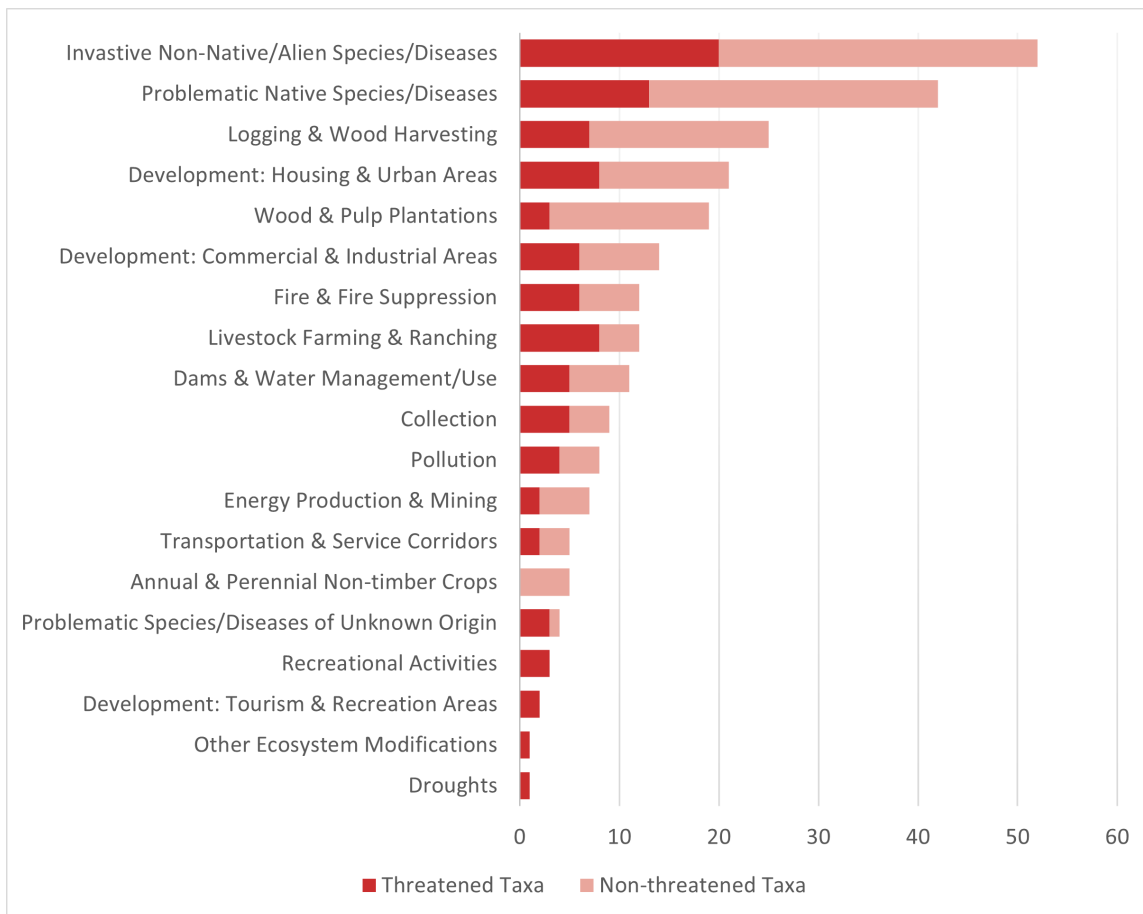


Figure 4: Number of taxa impacted by threats as categorized according to the IUCN-CMP Unified Classification of Direct Threats²¹.

The *Trillium* Collections at Mt. Cuba Center

Amy Highland, Mt. Cuba Center

Trillium experts from across the United States gathered together at Mt. Cuba Center in Hockessin, Delaware in October 2019. We all mused on the irony of being in a beautiful garden while storms trapped us indoors. We took advantage of the unprecedented gathering of botanical knowledge to assess the current state of the genus in the wild. In those rainy days, we saw the beauty and value of Mt. Cuba Center's *Trillium* Collections in a way most visitors cannot. The phenotypes, metadata, history, the commitment to the genus were all recognized as critically important. As we talked through each species, the conversation gradually turned from one of loss and destruction, to one of future needs and action. Actions such as the continued development of *ex situ* collections in conservation gardens around the world.

The *Trillium* Collection at Mt. Cuba Center began in the 1960s with the diminutive *Trillium nivale*. Our founder, Mrs. Pamela Copeland, was passionate about this uncommon wildflower and worked with Mt. Cuba's first director, Dr. Richard Lighty, to lay the foundations of our research ambitions. Repeated generations of leaders at Mt. Cuba Center have committed to this genus, creating a renowned and stately collection. In nearly 60 years of stewardship, the collection has grown to comprise 90 taxa represented by 463 accessions, including intergeneric hybrids, celebrated cultivars, and rare color forms. Wild documented mother lines round out the collection with much needed data and distinct genetic variability.

Over the years, prominent accessions were donated by Fred and Roberta Case, who authored the authoritative volume, *Trillium*, and named the beautiful double-form *Trillium grandiflorum* 'Pamela Copeland' for our founder, as a testament to their connection and mutual respect. Other notable additions originated from Louise Smith's Alabama home, and showcase the variation in the mottled, silver foliage of many sessile *Trillium*. These early partnerships not only added depth and interest to our *Trillium* collection, they demonstrated the ability of the collection to bring people together and create communities.

Working with our partners in conservation and horticulture, we bring together a collection of forms and ecotypes; turning our inspiring gardens into a living laboratory and productive seed bank. Threats and environmental demands are converging to push these valuable plants into decline in the wild. Mt. Cuba Center acts as an ark, an observer,

and a source of restoration materials. While also inspiring and motivating visitors to care about nature and the world around us through stunning *Trillium* displays.

Mt. Cuba Center's commitment to *Trillium* continues today and we are happy to join our partners to develop these vital species assessments. Truly great collections, built over time, tell us a good deal about ourselves and what we value. In these last few decades, botanical gardens have seen a shift in our living collections to include more plants of conservation concern, more plants native to the environments from which they came, and more interest in understanding the interactions among living things. We are delighted to witness this time of conservation action perpetuated by our gardens and the efforts of the *Trillium* Working Group.

A note on the taxonomy of *Trillium*

Edward Schilling, University of Tennessee

Aaron Floden, Missouri Botanical Garden

Wesley Knapp, NC Natural Heritage Program, NatureServe

Trillium includes about 60 species and is part of a group that was traditionally assigned to Liliaceae, recognized as its own distinct family, or most recently considered to be tribe Parideae of Melanthiaceae. This last placement, based on results from molecular phylogenetic studies, was unanticipated from earlier morphologically based classifications. Tribe Parideae, with over 90 species, represents a huge increase in diversity relative to its most closely related tribes, Xerophylleae (2 species), Chionographideae (8 species) and Heloniadeae (9 species). A major change in Parideae relative to the rest of the family is having a single flower with prolonged anthesis rather than a dense inflorescence of individually small, short-lived floral units. The tribe is also distinctive in having huge genomes, with *Kinugasasō* (*Paris japonica*) having the largest yet documented for a flowering plant species.

There is not yet unanimous opinion on the generic boundaries of *Trillium*⁴⁵. Molecular phylogenetic studies have identified a species from western North America with a *Trillium*-like appearance as a clearly distinctive entity, and it is now classified as *Pseudotrillium rivale*. Molecular data also suggest that the beautiful and distinctive Painted *Trillium* should be classified, together with a Himalayan species, in a distinct genus *Trillidium*, although the separation of these from *Trillium* is not universally accepted⁴⁶. The other genus in the tribe, *Paris*, is viewed variously as a single genus, or as a lineage that includes two other genera, *Daiswa* and *Kinugasa*. *Paris*, *Daiswa*, and *Kinugasa* are distinctive in having 4- to 11- merous flowers, compared to the trimerous flowers of *Trillium*, and the distribution of the *Paris* lineage is restricted to Asia and Europe⁴⁶.

The outlook on the infrageneric classification of *Trillium* has changed substantially with the availability of molecular phylogenetic data. The traditional view was a split between two subgenera, with the sessile-flowered species forming subgenus *Sessillium* (earlier called subgenus *Phyllantherum*), and the pedicellate-flowered species making up subgenus *Trillium*. Molecular data confirm the monophyly of subgenus *Sessillium* but show that subgenus *Trillium* is a paraphyletic group composed of several distinct lineages. Of these, only subgenus *Delostylium* has been named and formally circumscribed⁴⁷. The lineage that is sometimes referred to as the “Erectum Group” includes the type species of the genus, *T. cernuum*, and thus is automatically called subgenus *Trillium*. Two other lineages that appear to be distinctive but

have not been formally named are the “Ovatum Group” and the “Grandiflorum Group”.

The sessile-flowered group of *Trillium*, subgenus *Sessillium*, is well circumscribed by the lack of a flower pedicel above the bracts, and by the presence of mottling on the leaves. This group now includes over 25 species, including 3 species newly described in the last 12 years. The center of diversity for this group is in the southeastern U.S., but there is a secondary center in western North America where 5 species occur. Undescribed species may be presented in both geographic areas. The sessile-flowered *Trillium* are notable for the broad range of variation in floral scent, ranging from sweet lemony odors to quite repugnant carrion and excrement types. The chemical composition and ecological significance of these odors is an area of active investigation.

The sister group to the sessile *Trillium* appears to be subgenus *Delostylium*. The subgenus is distinctive in having the bases of the three stigmas united into a slender style above the ovary. About 12 distinct entities have been noted in this subgenus, although not all have been formally named. One of the rarest species of *Trillium*, *T. persistens* (Edna’s *Trillium*) is part of this subgenus and is listed as Endangered under the United States Endangered Species Act.

The “Erectum Group” includes species in North America that are closely related to *Trillium erectum* and all the Asiatic species of *Trillium*. This group is distinct in having short, stout stigmas that are recurved at the tip. The species-level taxonomy is incompletely resolved, particularly in North America. Unpublished dissertation studies based on isozymes and molecular markers have failed to find distinct boundaries between many of the species, and interspecific hybridization may be a factor. In Asia all but one of the species are polyploids, and interspecific hybridization has been documented.

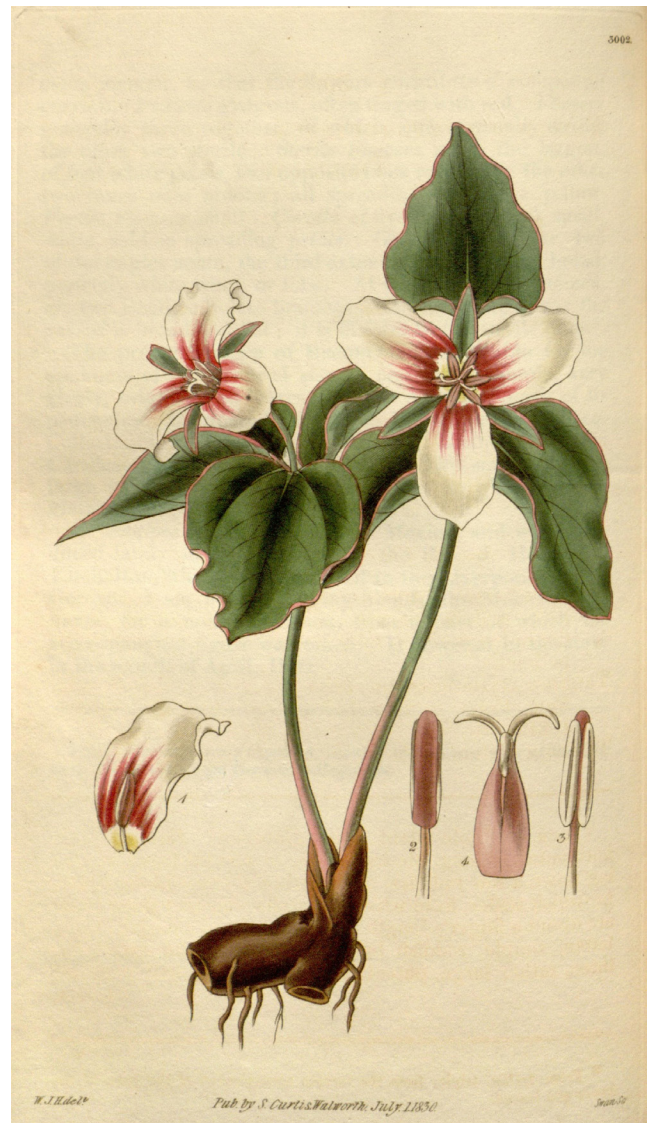
The “Ovatum Group” consists of a complex of closely related taxa that occur in western North America. *Trillium ovatum* was once thought of a single species, but molecular data suggest that at least four different species are now embraced under this name. The diminutive *Trillium hibbersonii* from Vancouver Island in Canada has recently been recognized as distinct from *T. ovatum* and shown to be part of the “Erectum Group”. *Trillium crassifolium* also is

distinct from the “Ovatum Group” and is instead part of the “Grandiflorum Group”, with some sources recognizing it as a distinct species.

The “Grandiflorum Group” includes at least two common species of North America, *T. grandiflorum* and *T. nivale*. These species are quite distinctive, with plants of *T. grandiflorum* large, robust, and midseason bloomers, whereas those of *T. nivale* are small, dainty, and among the earliest of the spring ephemerals to bloom.

Trillium exhibits a classical pattern of geographic distribution that was once termed Arcto-Tertiary, with centers of distribution in eastern and western North America and in eastern Asia. The area with the largest number of species is the southeastern United States. The number of species in western North America is far fewer, but the phylogenetic diversity in this area rivals that of eastern North America. In contrast, eastern Asia has many fewer species, and all of them belong to the same infrageneric lineage, the “Erectum Group”. Ongoing studies suggest that the disjunction among geographic areas was achieved not in a single event, but rather through multiple movements of different phylogenetic lineages within the genus.

Use of molecular genetic markers has helped to solidify *Trillium* taxonomy and aid in conservation assessments. This is needed because of the overall similar appearance of all *Trillium*, and the tendency for teratogenic forms (such as having doubled flowers or atypical numbers of floral parts) to occur in many species. Use of genetic markers led to recognition of *Trillium delicatum*, and to clarification of the distinctiveness of *T. hibbersonii*, both of which are rare and in need of protection. Conversely, molecular markers show that *Trillium ovatum* var. *maculosum* is merely a local form of typical *T. ovatum* with oddly spotted leaves which is not genetically different from it. Future studies are still needed to clarify the taxonomy of the “Ovatum Group”, which may include one or more rare species of conservation concern that are not currently recognized.



William Jackson Hooker's 1830 illustration depicting *Trillidium undulatum*.

On western *Trillium*

Kjirsten A. Wayman, Humboldt State University

While western *Trillium* do not have the significant cultural and medicinal history that eastern *Trillium* have, they are revered by plant enthusiasts and the public for their undeniable beauty. Depending on the species and the localities where they occur, western *Trillium* begin blooming in mid-winter or early spring as some of the first flowers of the year, adding to their attraction.

In western North America there are anywhere from six to ten recognized species of *Trillium*, a few of which have noted varieties or subspecies. Of these, five are sessile (the flower is stalk-less) and one species complex is pedicellate (the flower is born on a stalk).

Trillium ovatum, the pedicellate species complex, shows widely varying morphology across its range. There are up to 5 taxa within this complex, one of which, *T. hibbersonii*, was recently determined to be distinct from *T. ovatum*. Future research will provide greater clarity on whether the other recognized taxa in this complex, *T. crassifolium*, *T. ovatum* subsp. *oettingeri*, and *T. scouleri*, are justified as distinct species from *T. ovatum* subsp. *ovatum*.

The five species of currently recognized western sessile *Trillium* are *T. albidum* (subsp. *albidum* and subsp. *parviflorum*), *T. angustipetalum*, *T. chloropetalum* (var. *chloropetalum* and var. *giganteum*), *T. kurabayashii*, and *T. petiolatum*. Some treatments elevate *T. albidum* subsp. *parviflorum* to the species level, and other treatments combine *T. kurabayashii* with *T. angustipetalum*. There is also taxonomic uncertainty regarding the varieties of *T. chloropetalum*. While *T. petiolatum* is very distinct, the other four sessile-flowered species have many overlapping traits among them and significant infraspecific variability, making species boundaries difficult to define and identifications troublesome in many cases. These variable traits include petal color, petal shape, stamen to ovary ratio, ovary color, stamen color, mode of anther dehiscence, among others. Molecular data published to date have been unable to resolve these species, likely due to their more recent divergence in evolutionary history. Owing to their great variety of petal colors and shapes, the interesting mottling patterns on their leaves, and pleasing or curious floral scents, *Trillium* enthusiasts are drawn to these plants and search far and wide to discover the full extent of their variation. The mystery of their taxonomy remains unsolved; however, a bit of clarity is gained with each research study that is pursued.

In addition to the taxonomy, the insects that may be responsible for pollination of the western sessile *Trillium* species are also a mystery. While many tiny beetles have

been observed in and around the flowers, it is still unclear whether beetles are the pollinators, whether self-pollination is sufficient, or if another mechanism is operating. Hybridization and introgression of the western sessile *Trillium* also appear to be occurring in various regions of the Pacific west, seen in the intermediate morphology of select populations.

The main threats to *Trillium* populations in the west are the loss of habitat due to wildfire or encroaching development. It is still unclear how severe the effect of wildfire is, or will be, on *Trillium* populations. The *Trillium* plants themselves can easily survive a wildfire as their rhizomes are well underground and the above ground foliage has usually died back before the arrival of fire season. However, the changing vegetation and increase in low growing shrubs and herbaceous plants after a fire may decrease the survival of existing *Trillium* plants and recruitment of seedlings.

Floral scent, taxonomy, and ecology of *Trillium* in North America

Kjirsten A. Wayman, Humboldt State University

Robert A. Raguso, Cornell University

Many people are surprised to learn that *Trillium* flowers often are strongly and distinctively scented. This may reflect that *Trillium* flower close to the forest floor where they are rarely sniffed, or that their fragrances dissipate in the open, breezy landscapes in which they bloom. Perhaps people are simply charmed by their colorful displays. Nevertheless, most *Trillium* flowers are scented in ways that provide information about their taxonomic and ecological relationships.

Floral scent is another character, like petal color, petal shape or petal number, that can be used to describe a plant. While floral scent cannot be as easily or reliably described based on human perception, its chemical composition can be analyzed. The floral scent in *Trillium*, mainly originating from the petals, is composed of volatile organic compounds that can be absorbed onto a substrate and subsequently injected into a gas chromatograph – mass spectrometer for chemical analysis. Morphological characters are generally used to identify a particular taxon, and floral scent composition can similarly be used in *Trillium* as a key identifying trait.

Floral scents usually represent blends of volatile organic compounds produced by different biosynthetic pathways. Scent blends can be simple (3-5 related compounds in petunias) or complex (over 100 diverse compounds in the common sunflower). Esters, ketones, alcohols, monoterpene and sesquiterpene hydrocarbons, oxygenated terpenes, benzenoid compounds and organosulfur compounds are the dominant types of volatiles found in *Trillium* floral scents (Fig 5). Some compounds are present across multiple species, while others are unique to a particular taxon or found only in a few species. Generally, however, the set of compounds and the ratio in which they occur is unique to a given species (including any variation that may also exist). For example, candy-sweet smelling 6-methyl-5-hepten-2-one (also known as sulcatone) is found in significant quantities in *T. kurabayashii*, whereas it is sometimes a minor compound in *T. albidum* or *T. chloropetalum* and is never found in *T. angustipetalum* (Wayman, unpublished results, Fig 6).

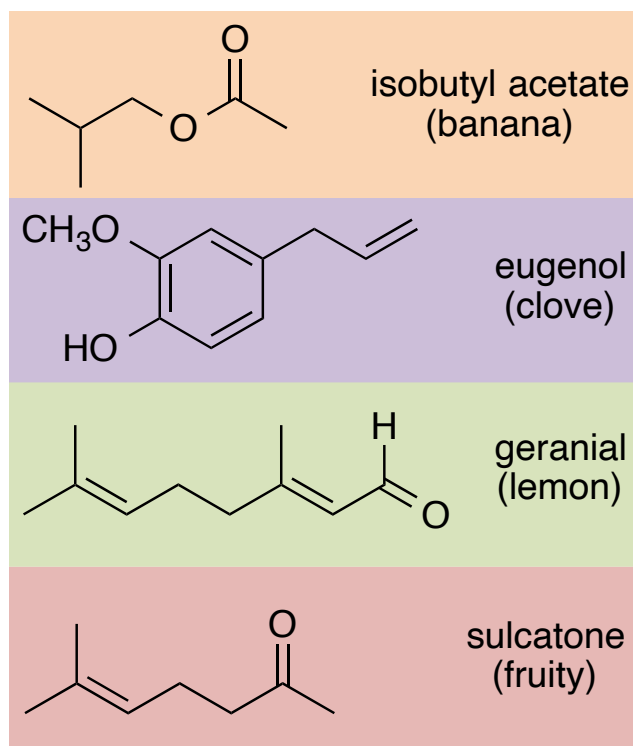


Figure 5: Representative examples of compounds in *Trillium* species.

Thus, floral scent composition can be thought of as a signature of a particular species. Although there may be variation within a species and among populations, the set of compounds characteristic of a species or population generally remains consistent. In this way, the floral scent composition can behave as a species marker. When Victor Soukup²⁵ discovered *T. parviflorum* (currently *T. albidum* subsp. *parviflorum*) in the Pacific Northwest, he described the flowers as having a distinctive “clove-like” scent, which he felt was a unique trait to *T. parviflorum*, distinguishing it from the closely related *T. albidum*. Subsequent research has identified eugenol as the chemical source of the clove-like scent in *T. parviflorum*. However, discovering its presence in a few northwestern populations of *T. albidum* revealed that eugenol is not unique to *T. parviflorum* (Wayman, unpublished results). In this case, a shared floral scent trait challenges us to reassess our species concept for *T. albidum* and consider whether currently isolated northwestern populations are relicts of a historically broader and less fragmented distribution.

Embedded within the species-specific floral scent blends

of many *Trillium* are individual volatile compounds with distinctive ecological roles. For example, dimethyl disulfide lends a sharp, fetid odor to the unusual maroon flowers of *T. petiolatum*. This compound is universally present in flowers that mimic carrion, including some of the world’s largest and strangest flowers (*Dead Horse Arum*, *Rafflesia*, *Stapelia* and *Aristolochia*), all of which are pollinated by Blowflies (*Calliphoridae*)³⁶. Interestingly, dimethyl disulfide is produced by several red-flowered, sessile *Trillium* species native to southeastern USA that are not each other’s closest relatives, suggesting independent origins of carrion mimicry in the genus. Other *Trillium* with similar red, sessile flowers produce volatiles indicative of ripe fruit (isobutyl acetate), yeast (acetoin) or dung (*p*-cresol). From an ecological standpoint, these findings predict that different kinds of pollinators (e.g., sap beetles, fruit flies and dung flies or beetles, respectively) should be attracted to these *Trillium* species, perhaps as a mechanism to reduce competition for pollinators. From an evolutionary standpoint, such findings suggest that pollination systems have diversified through chemical mimicry of different kinds of decaying substrates in the genus *Trillium*.

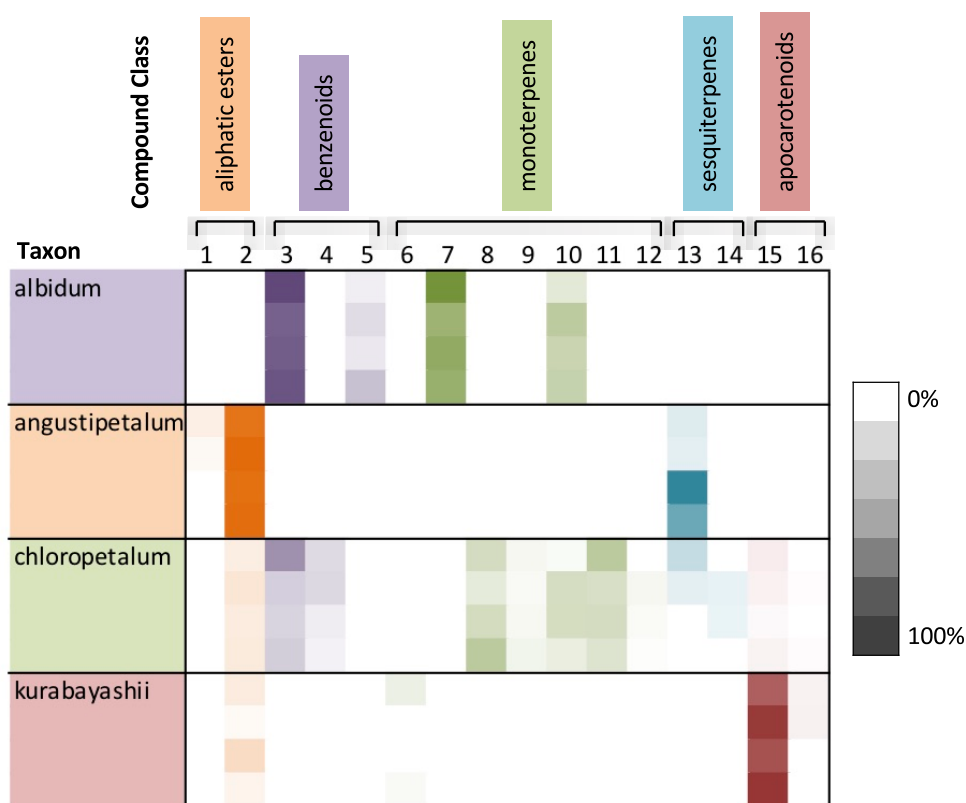


Figure 6: A heat map showing relative percentages of compounds in the total floral scent of 4 individuals from a single population of each species. Taxa include *T. albidum*, *T. angustipetalum*, *T. chloropetalum*, and *T. kurabayashii*. Numbers 1-16 represent individual compounds.

History of Medicinal Use

Susan Leopold, United Plant Savers

Trillium have a rich history in medicinal use in the United States but also in China, India, Pakistan and other regions around the world where they grow. The bioactive components of *Trillium*, steroidal saponins, are contained in their roots⁴⁸. *Trillium* are known to be astringent, tonic, and antiseptic⁴⁹. This makes for wide application in *Trillium* being used as an ingredient in herbal formulas as well as being used as a single tincture. Its common names, 'Birth Root' or 'Beth Root', reflect a history of being used for women during and after birth and for preventing and mitigating hemorrhages⁵⁰. The history of side income derived from trapping for the fur trade as well as digging roots and harvesting barks for the medicinal plant trade dates back to 1700s in rural Appalachia. Much of the plant knowledge and formulation of herbal products is based on folk knowledge that has been passed down over generations, much of it derived initially from Indigenous practitioners⁵¹. The demand for herbal products in the United States hit a peak during the late 1800's and early 1900's when there were many schools of eclectic medicine that promoted the use of plant-based remedies. It was common in this period for small store to purchase a plethora of herb-based medicines. This all changed with increasing dominance of allopathic trained doctors and the development and use of synthetically produced derived medicines⁵¹.

Currently we are witnessing a renaissance in the demand for plant-based products that are now regulated under the Dietary Supplement Act passed in 1994. The legislation provides some regulation for herbal products but clearly states that no medical claims can be made on herbal products⁵². This regulation, however, has created challenges on how products are marketed and formulated because while there are guidelines on processing plants, sourcing and purity standards are lacking. Companies are required to document some form of tracking the plants in the supply chain, but current techniques are unable to properly identify similar species and a company is only held accountable if they are audited by the FDA⁵³. Plants that are used in the making of pharmaceutical grade drugs have to comply with much stricter conservation protocols but for those regulated by the Dietary Supplement Act, requirements on sustainability do not apply.

Information on the trade

While there are international laws regulating trade of medicinal plants, trade within the United States is largely unregulated and quantifying the magnitude of trade is difficult. On public lands, such as National Forests, a

permit may be required for digging plants but the process varies across Forests, and in most cases plants on private lands can be collected without state or federal permits. Social media has become a place where thousands of root diggers and buyers connect, as well as offering visual evidence of the toll taken on native plant populations. In a volunteer survey of American Ginseng (*Panax quinquefolius*) dealers in a few southern states, the Department of Forest Resources and Environmental Conservation at Virginia Tech reported that between 2013–2016, 1,338 pounds of *Trillium* were purchased at an average price of \$3.11 per pound⁴¹. It is important to note that the number of dealers surveyed was a fraction that purchased in those years, and with approximately 200 dried *Trillium* rhizomes making a pound, the number of plants removed from the wild is in the hundreds of thousands.

What's more, this data point represents wild collection for the medicinal plant trade only, and it is widely known that these plants are sold as ornamental plants by nurseries. Even though native plant regional societies and native plant nurseries have clear guidelines, *Trillium* are a highly sought-after plant in the nursery trade for its beautiful flowers and fondness as a spring ephemeral. Individual plants sell anywhere from 5 to 15 dollars, with rarer varieties commanding even higher prices. The nursery trade in *Trillium* is also difficult to study due to its highly dispersed nature, and a lack of supply chain monitoring. There is a huge discrepancy is the value of *Trillium* as a living plant in the nursery trade and the value of the dried root for the medicinal plant trade. How can 100 plants be valued at 1 to 3 dollars when sold on herbal markets while the same plants could command 500 dollars in horticultural markets? In part, this can be attributed to lack of understanding of the dealers and brokers involved in horticultural trade. Markups prior to entering horticultural markets are likely, and it's unclear how prices paid to diggers vary. In conversations with dealers, they lament that it is difficult to find diggers who have harvested and dried *Trillium* when they can sell a single rhizome fresh for a higher price to those looking to repot and sell into the nursery plant trade. In personal comments from a digger, the dealer told the digger that if she didn't dig *Trillium* in the spring then the dealer would not buy the digger's much more lucrative American Ginseng harvest in the fall.

Ending the *Trillium* Trade in Commercial Herbal Products

United Plant Savers, a non-profit founded in 1994 dedicated to native medicinal plant conservation, lists *Trillium* on its At-Risk list. There are several common species that are abundant and easy to cultivate that provide accessible analogues for the traditional uses of *Trillium*. Mother Wort (*Leonurus cardiaca*) is purported to be an effective uterine tonic. Yarrow (*Achillea millefolium*) is often stated to be very effective as an anti-hemorrhage herb as is Shepherd's Purse (*Capsella bursa-pastoris*), which is also purported to be effective as an astringent. Raspberry leaf (*Rhus idaeus*) is used commonly used to tonify the reproductive system. United Plant Savers supports the work of those who are dedicated to cultivating *Trillium* for the horticulture trade and for conservation purposes. Without any efforts to use cultivated sources of *Trillium* for the commercial trade in herbal products compounded by the fragility of such a slow growing woodland spring ephemeral, United Plant Savers advocates for the ending of the *Trillium* trade in commercial herbal products.



Illustration of *Trillium erectum* by Charles Millspaugh. This image is included in his 1887 volume *American Medicinal Plants: An Illustrated and Descriptive Guide to the American Plants Used as Homeopathic Remedies*.

Species Assessments

The following pages contain individual assessments for Trillium taxa assessed by both NatureServe and the IUCN Red List. Accounts include relevant data that support each taxon's conservation status and a map of the taxon's range. Maps incorporate information on the origin and presence of taxa in each area.

Species accounts are structured as follows:

Binomial name

Authority

Pedicellate or Sessile

Red List Category & Criteria NatureServe Global Rank

CA: Canadian provinces where taxon occurs

US: States where taxon occurs

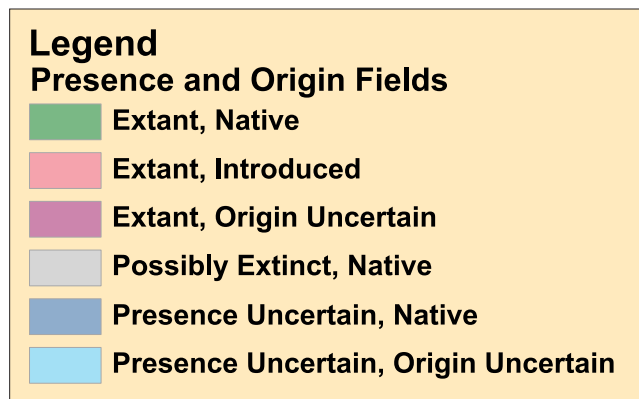


Figure: 7 Key to presence and origin designations in maps.

Narrative justification

Red List Assessor(s)

NatureServe Global Rank Reviewer(s)

References

States and provinces may also include qualifiers providing additional information about occurrences in these areas as follows:

- ^H Historical occurrences which may or may not persist at present
- ^I Introduced
- ^U Origin uncertain

Pseudotrillium rivale

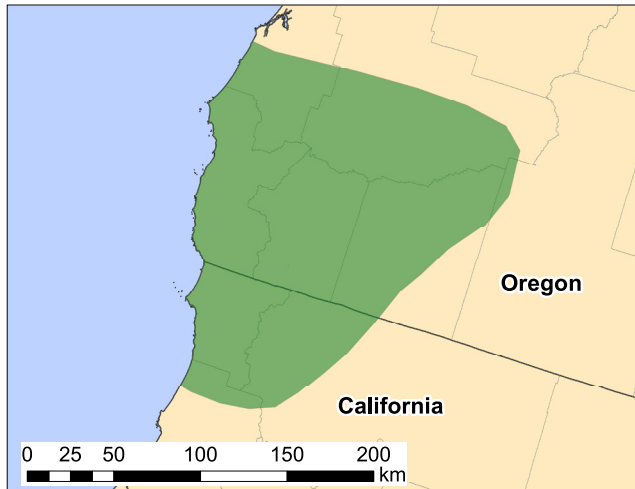
(S.Watson) S.B. Farmer

Pedicellate

Vulnerable B1ab(iv)

US: CA, OR

Vulnerable (G3)



Brook Wakerobin (*Pseudotrillium rivale*) occurs in the Klamath and Siskiyou Mountains of northwestern California from northern Humboldt County, western portions of Siskiyou County and throughout Del Norte County, north to Coos, Curry, Jackson, and Josephine Counties, in Oregon. It is locally common on moist serpentine soils in association with open yellow-pine forests, manzanita chaparral, clearings in sequoia groves, riparian areas, *Darlingtonia* bogs, and gravelly roadsides. The species is threatened by disruptions to natural fire regimes that have resulted in heavy accumulated fuel loads. The 2002 Biscuit fire burned the entire species' range, likely resulting in decreased habitat quality. The species may also be threatened by Elk (*Cervus canadensis*) predation, invasive plants, and logging. Most of the species' range falls within the Rouge River-Siskiyou National Forest, but existing protections may not adequately address threats.

Red List Assessor(s): Wayman, K.A., Meredith, C.R. & *Trillium* Working Group 2019

NatureServe Global Rank Reviewer(s): Wayman, K.A. & Oliver, L.

Refs: 1, 11, 13, 15, 42, 48, 49, 54–76

Trillidium undulatum

(Willd.) Floden & E.E. Schilling

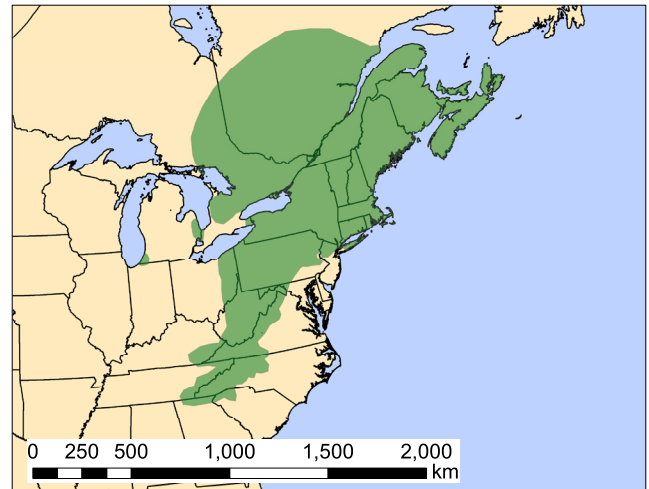
Pedicellate

Least Concern*

CA: NB, NS, ON, PE, QC

US: CT, GA, KY, MA, MD, ME, MI, NC, NH, NJ, NY, OH, PA, RI, SC, TN, VA, VT, WV

Secure (G5)



Painted Trillium (*Trillidium undulatum*) is broadly distributed from Ontario, Quebec, and Nova Scotia south through the Appalachian Mountains to Georgia. It occurs in a variety of habitats and forest communities, and requires cool acidic soils. In the southern part of its range, it only occurs at elevations greater than 600 meters. The species' population is not well understood and additional research is needed to determine the population trend. It is threatened by herbivory pressure associated with an overabundance of White-tailed Deer, habitat degradation caused by feral Pigs, and soil acidification caused by air pollution. Though the population trend is not well understood, given the species' broad range there is a very low risk of extinction.

*The Red List includes *Trillidium undulatum* as a synonym of *Trillium undulatum* Willd.

Red List Assessor(s): Meredith, C.R. & *Trillium* Working Group 2019

NatureServe Global Rank Reviewer(s): Treher, A.

Refs: 1, 11, 13, 24, 25, 48, 49, 54, 55, 57, 59, 69–74, 76–85

Trillium albidum

J.D.Freeman

Sessile

N/A Apparently Secure (G4G5)

US: CA, OR, WA

The taxonomic status and rank of *Trillium albidum*, and its infraspecies, are unclear, and in recent treatments members of the species complex have been recognized at both the species and subspecies levels. They are treated here in a strict sense, with NatureServe recognizing two taxa at the subspecies level. The Red List includes both taxa at the species level. However, the species concepts employed in both frameworks are synonymous. Considered in the broad sense, both authorities agree that the risk of extinction for the species complex is low.

Refs: 1, 11, 48, 49, 57, 69, 71–74, 76, 83, 84, 86, 87

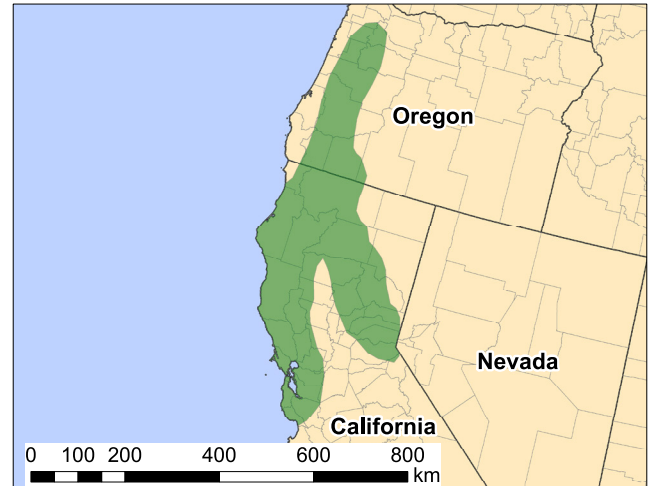
Trillium albidum subsp. *albidum*

J.D.Freeman

Sessile

Least Concern* Apparently Secure (T4T5)

US: CA, OR



Giant White Wakerobin (*Trillium albidum* subsp. *albidum*) occurs in mountainous areas, extending from Monterey County, California north along the Coast Range to Columbia County, Oregon as well as in the Cascade, Klamath, and Sierra Nevada Mountains. It occurs in various habitats including redwood forest edges, mixed deciduous-coniferous forests, coastal scrub, chaparral, moist canyon slopes, and riparian areas. Extensive hybridization occurs with *T. albidum* subsp. *parviflorum* in northern parts of its range, and with *T. chloropetalum* in the San Francisco Bay Area. Wildfire, urban development, and invasive plants could impact some subpopulations; however, it is relatively tolerant of disturbance. This taxon is at low risk of extinction due to its relatively large population, extensive range, and absence of specific threats.

*The Red List includes *Trillium albidum* subsp. *albidum* as a synonym of *Trillium albidum* J.D. Freeman

Red List Assessor(s): Wayman, K.A., Meredith, C.R. & *Trillium* Working Group 2019

NatureServe Global Rank Reviewer(s): Wayman, K.A. & Oliver, L.

Refs: 1, 11–13, 15, 42, 48, 49, 54, 56, 57, 67, 69, 71–74, 76, 83, 84, 86–90

Trillium albidum subsp. *parviflorum*

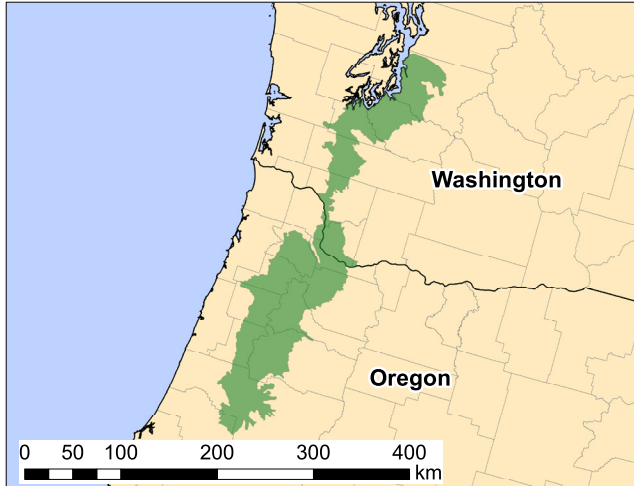
(V.G. Soukup) K.L. Chambers & S.C. Meyers

Sessile

Vulnerable C2a(i)*

Imperiled (T2T3)

US: OR, WA



Smallflower Trillium (*Trillium albidum* subsp. *parviflorum*) is endemic to the Puget Trough ecoregion of northwestern Oregon and southwestern Washington. The species occurs in oak and hardwood communities and wetland habitats, which are increasingly threatened by development within the region. Other threats include changes to hydrology, competing invasive plants, and timber harvest. Conservation efforts for the species should be focused on protecting and maintaining adequate amounts of suitable habitat. The population is small and thought to be in decline. Just over 5,000 plants occur in Washington and probably fewer than 1,000 in Oregon. The largest known subpopulation, located on the Fort Lewis Military Reservation, is under 1,000 individual plants. Due to its limited, declining population, the taxon is considered at moderate to high risk of extinction.

*The Red List includes *Trillium albidum* subsp. *parviflorum* as a synonym of *Trillium parviflorum* V.G.Soukup

Red List Assessor(s): Meredith, C.R. & *Trillium* Working Group 2019

NatureServe Global Rank Reviewer(s): Oliver, L. & Wayman, K.A.

Refs: 1, 11–13, 43, 48, 49, 54, 56, 59, 61, 71–74, 76, 83, 84, 86–88, 91–100

Trillium angustipetalum

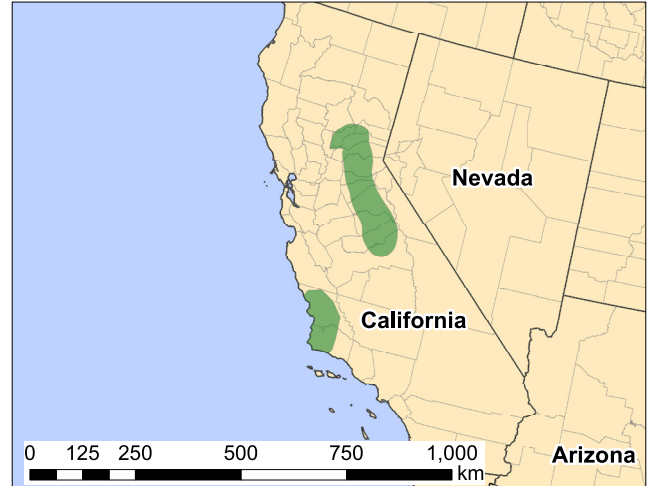
(Torr.) J.D.Freeman

Sessile

Data Deficient

Apparently Secure (G4)

US: CA



Narrowpetal Wakerobin (*Trillium angustipetalum*) occurs in the Sierra Nevada Range of California from Fresno County to Yuba County. Disjunct subpopulations also occur in Santa Barbara and San Luis Obispo Counties. It is noted to be uncommon, and occurs in montane areas including mixed conifer forests, relatively moist woodland foothills, and riparian areas. It is found in association with sequoia in the Sierra Nevada, and with maples, and oak groves in riparian areas extending into chaparral habitats at lower elevations. There are few documented threats to this species, although Himalayan blackberry is likely to present some level of competition, which may be facilitated by fire risk in the species' habitat. It is known to occur in several protected areas including Montaña de Oro State Park, in San Luis Obispo County, and Yosemite National Park. Due to the lack of information on population size and trend, as well as specific threats, this species is listed as Data Deficient on the Red List. NatureServe considers the species as Apparently Secure; however, if the disjunct subpopulations are excluded, the species' Global Rank would be more imperiled.

Red List Assessor(s): Wayman, K.A., Meredith, C.R. & *Trillium* Working Group 2019

NatureServe Global Rank Reviewer(s): Wayman, K.A. & Oliver, L.

Refs: 1, 11, 15, 48, 49, 54, 55, 57, 66, 67, 69, 71–74, 76, 83, 84, 86, 101–106

Trillium catesbaei

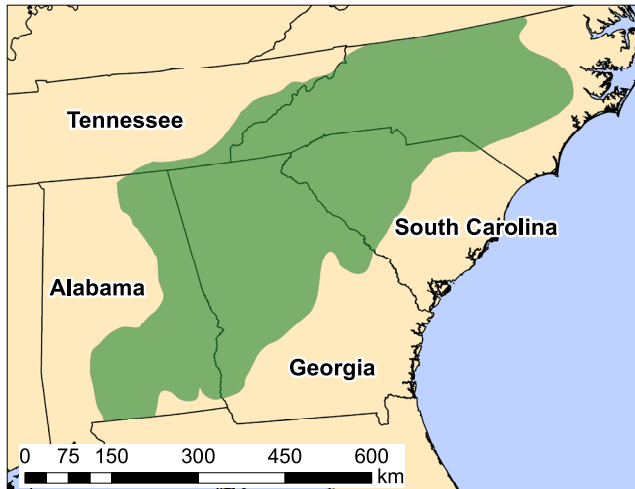
Elliott

Pedicellate

Least Concern

Apparently Secure (G4G5)

US: AL, GA, NC, SC, TN



Bashful Wakerobin (*Trillium catesbaei*) occurs in the southern Piedmont region from North Carolina south to Alabama. The species is also present in the Tennessee Valley in Tennessee, Georgia, and Alabama, as well as portions of the Gulf Coast Plain in southern Alabama, and rarely on the Coastal Plain of North Carolina. Within this range, it occurs on acidic soils in cove forests, laurel and rhododendron thickets, and open dry woodlands. It often occurs in areas where habitats are unsuitable for other *Trillium* species but has a somewhat unpredictable distribution and a highly variable population density. The species is commercially available as an ornamental, but the market for the species is quite small. The primary threat to this species is herbivory from an overabundance of White-tailed Deer within its range. The species occurs in several protected areas including the Great Smoky Mountains National Park, but most of the species' range is not protected. Given the species' wide range and large population, it is at low risk of extinction.

Red List Assessor(s): Meredith, C.R. & *Trillium* Working Group 2019

NatureServe Global Rank Reviewer(s): Treher, A. & Frances, A.

Refs: 1, 2, 11, 13, 15, 25, 26, 29, 32, 48, 49, 54, 55, 57, 69, 71–74, 76, 81, 83–86, 91–93, 102, 106–112

Trillium cernuum

L.

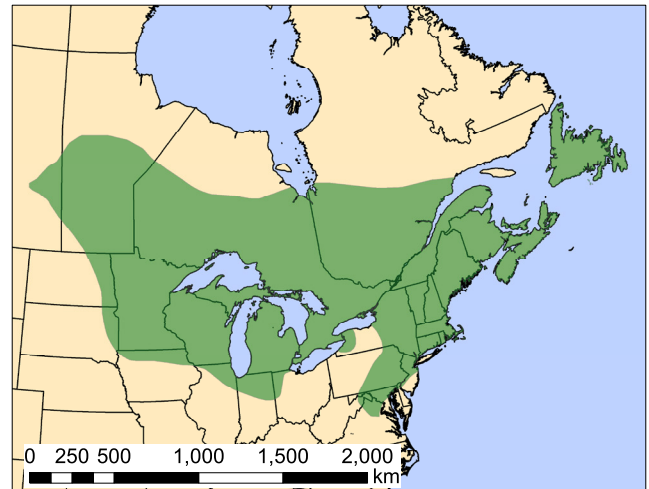
Pedicellate

Least Concern

Secure (G5)

CA: MB, NB, NL, NS, ON, PE, QB, SK

US: CT, DE, DC, IL, INH, ME, MD, MA, MI, MN, NH, NJ, NY, ND, OH, PA, RI, SD, VT, VA, WV, WI



Nodding Trillium (*Trillium cernuum*) occurs across a broad range in northeastern North America from Saskatchewan, east to the Canadian maritime provinces, and as far south as northern Virginia. Though population declines have been noted, the species is quite abundant, especially in Michigan. It occurs in deciduous forests in its southern distribution, and extends into coniferous forests within its northern range. It is commonly found in wetland areas. Historically, habitat loss was this species' greatest threat; however, herbivory from an overabundance of White-tailed Deer is currently the primary threat. Competition with introduced Garlic Mustard also impacts some subpopulations. Despite its listing as Endangered by the states of Illinois and Indiana, and some indications of population decline in other places, the species is widespread and relatively common.

Red List Assessor(s): Meredith, C.R. & *Trillium* Working Group 2019

NatureServe Global Rank Reviewer(s): Treher, A.

Refs: 1, 11, 13, 15, 24, 25, 29, 32, 48, 49, 54, 55, 57, 59, 69, 71–74, 76, 81, 83, 84, 86, 108, 110, 113–118

Trillium chloropetalum

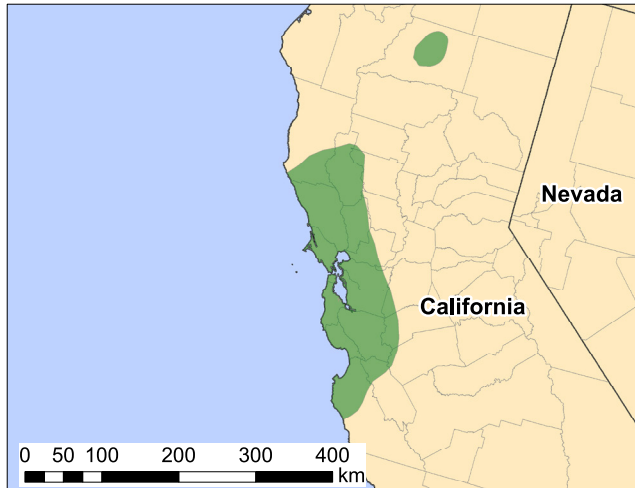
(Torr.) Howell

Sessile

Data Deficient

Apparently Secure (G4)

US: CA



Giant Trillium (*Trillium chloropetalum*) is a California endemic found generally in the Greater San Francisco Bay Area from northern Monterey County to southern Mendocino County. The species' population trend is unknown, but it is often abundant in city parks and gardens. Ethnographic accounts document use of the plant as an analgesic and as a burn dressing among the Costanoan, and Yurok tribes, respectively. It is one of the most widely cultivated species of *Trillium* in the horticultural trade. Wild collection is thought to supply a substantial portion of this market. Urban growth may present some threat to the species, though it is tolerant of small patches of habitat in parks and open spaces. Wildfire may also be a threat to this species. There is taxonomic uncertainty within the species, and some sources recognize material considered here as variety *giganteum* (Hook. & Arn.) Munz at the species level. Due to the taxonomic uncertainty, this species is listed as Data Deficient by the Red List. Should two distinct species become formally recognized, the species elevated from var. *chloropetalum* would likely be listed in a threatened category. *Trillium chloropetalum*, including the material that would be assigned to *giganteum*, is considered to be at low risk of extinction by both the Red List and NatureServe.

Red List Assessor(s): Wayman, K.A., Meredith, C.R. & *Trillium* Working Group 2019

NatureServe Global Rank Reviewer(s): Oliver, L. & Wayman, K.A.

Refs: 1, 11, 13, 48, 49, 54–57, 59, 61, 64, 67, 69, 71–74, 76, 83, 86, 101, 110, 119–121

Trillium cuneatum

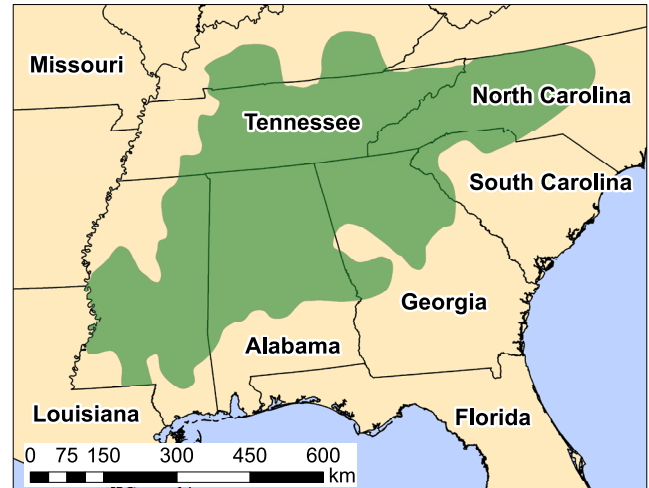
Raf.

Sessile

Least Concern

Apparently Secure (G4G5)

US: AL, GA, IL¹, KY, MD¹, MI¹, MS, NC, PA¹, SC, TN, VA^U



Cuneate Trillium (*Trillium cuneatum*) occurs from central North Carolina and southern Kentucky to Georgia and Mississippi. The species is known to have escaped cultivation in Michigan and may also have been introduced to Illinois, Maryland, Pennsylvania, and Virginia. In favorable habitats, the species may be a common component of understory communities. It occurs in upland woods and disturbed areas including mine tailings, ditches, and old fields. Several cultivars of this species are available commercially. The impact of horticultural trade on the wild population is unknown. An overabundance of White-tailed Deer and competition with invasive plants, specifically, Bush Honeysuckle and Chinese Privet, are the most significant threats to the species. Additional research is needed to determine the population trajectory for the species. Due to its wide range and large population, the species is not considered to be at risk of extinction.

Red List Assessor(s): Meredith, C.R. & *Trillium* Working Group 2019

NatureServe Global Rank Reviewer(s): Frances, A.

Refs: 1, 2, 11, 13, 15, 32, 48, 49, 54, 55, 57, 59, 64, 69, 71–74, 76, 81, 83, 84, 86, 108, 113, 122–125

Trillium decipiens

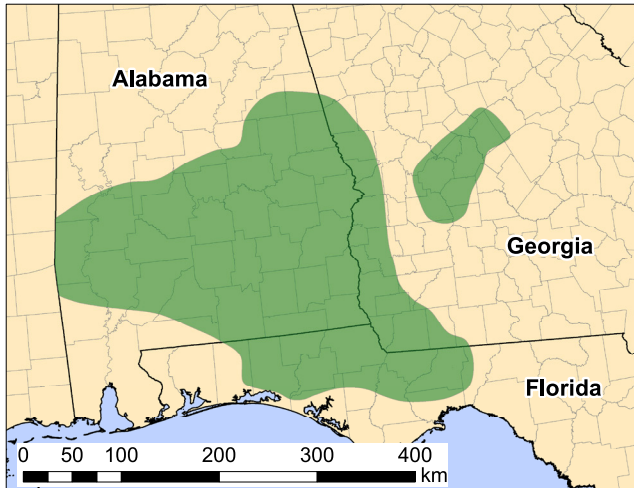
J.D.Freeman

Sessile

Least Concern

US: AL, FL, GA

Vulnerable (G3G4)



Deceiving Trillium (*Trillium decipiens*) is distributed within the Gulf Coast Plain of western Florida, southern Alabama, and portions of Georgia. It occurs on a variety of soil types but is most common on sandy calcareous substrates within mixed deciduous communities and upland oak woods. Logging and silviculture present the most substantial threats to this species. Other threats include herbivory by the overabundance of White-tailed Deer, invasive plants including Silverberry and Chinese Privet, rooting by feral Pigs, and infection from an unknown fungal species that inhibits reproduction. Despite the presence of threats to the species, it is considered to be at low to moderate risk of extinction.

Red List Assessor(s): Meredith, C.R. & *Trillium* Working Group 2019

NatureServe Global Rank Reviewer(s): Treher, A.

Refs: 1, 11, 12, 14, 15, 25, 31, 48, 49, 54, 55, 57, 59, 69, 71–74, 76, 81, 83–86, 101, 108, 109, 113, 126–128

Trillium decumbens

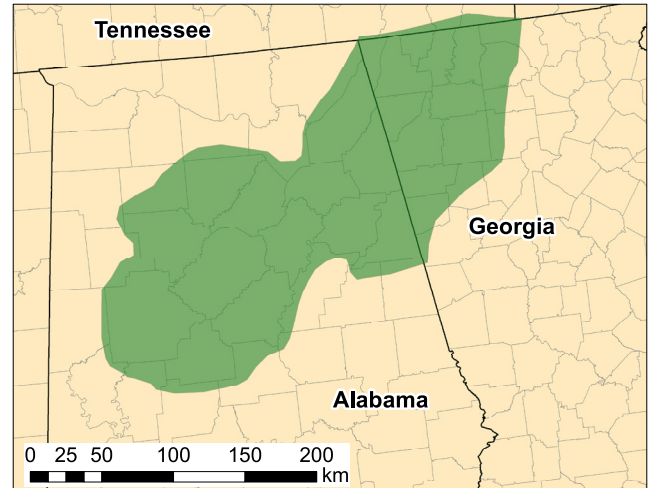
Harb.

Sessile

Least Concern

US: AL, GA, TN

Apparently Secure (G4)



Decumbent Trillium (*Trillium decumbens*) occurs in the Ridge and Valley, and the Cumberland Plateau physiographic provinces of Alabama, Georgia, and Tennessee. It is reported to be locally abundant throughout its range occurring in densely wooded areas on rocky substrates and riparian areas. In addition, it is collected as an ornamental, and may be threatened by logging. Mining, damage caused by feral Pigs, and herbivory associated with an overabundance of White-tailed Deer also threaten the species. Since threats to the species are currently low in intensity and unlikely to result in serious population declines, it is not considered to be at significant risk of extinction. Additional research is needed to determine the suitability of remediated mines as habitat for the species and the effectiveness of different remediation methods. Population monitoring is warranted given the nature of the threats to the species and its limited range.

Red List Assessor(s): Meredith, C.R. & *Trillium* Working Group 2019

NatureServe Global Rank Reviewer(s): Treher, A. & Frances. A.

Refs: 1, 11–13, 48, 49, 54, 55, 57, 59, 69, 71–74, 76, 77, 83, 84, 86, 101, 108, 117, 124, 129–131

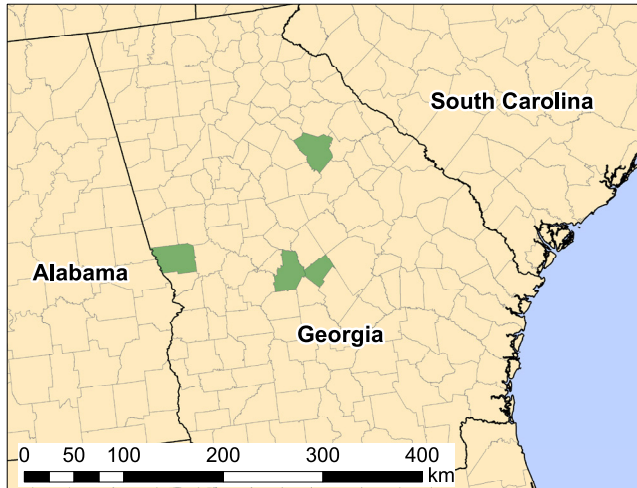
Trillium delicatum

A.Floden & E.E.Schill.

Sessile

Endangered B1ab(iii,v) Critically Imperiled (G1)

US: GA



Ocmulgee Trillium (*Trillium delicatum*) is known from four scattered subpopulations in the Ocmulgee and Oconee River drainages in Bleckley, Greene, Harris, and Houston Counties, Georgia. The subpopulation from Harris County was reported after the assessment process and has not been verified. It is not reflected in the status of the species. Habitat loss and degradation resulting from logging activities and feral Pigs are the primary threats to the species. Rooting by feral Pigs disturbs the plants and has negatively impacted at least one subpopulation. Efforts undertaken by the Georgia Department of Natural Resources have prevented total extirpation of the species at two additional sites. Control of feral Pig populations is vital to the continued survival of the species, and additional efforts are needed to prevent further loss of the remaining *T. delicatum* subpopulations. The species is at a high risk of extinction due to its limited range, ongoing habitat loss and degradation, and continuing population decline.

Red List Assessor(s): *Trillium* Working Group 2019 & Meredith, C.R.

NatureServe Global Rank Reviewer(s): Tomaino, A.

Refs: 1, 11, 15, 48, 49, 55, 57, 58, 69, 71–74, 76, 83, 84, 86, 132

Trillium discolor

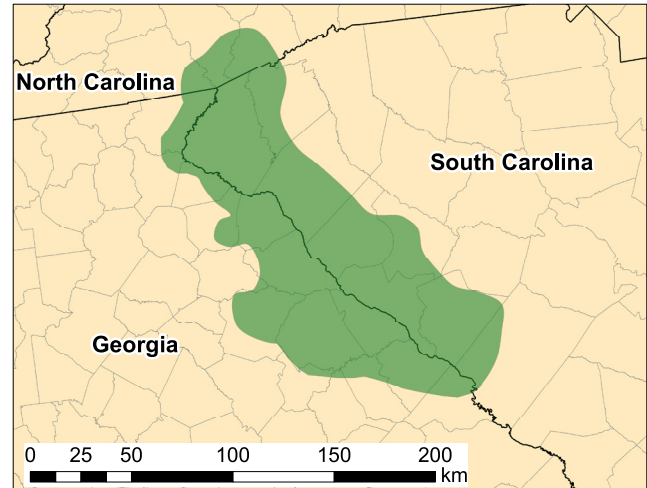
T. Wray ex Hook.

Sessile

Near Threatened

US: GA, NC, SC

Vulnerable (G3)



Pale Trillium (*Trillium discolor*) is endemic to the upper Savannah River drainage in Georgia, North Carolina, and South Carolina. Within its limited range, it is locally frequent in mixed deciduous forests on rich soils, upland slopes, and floodplains. Live plants are sold in ornamental plant markets, and wild collection may negatively impact the species' population. Other threats include habitat loss due to residential development, herbivory pressure associated with an overabundance of White-tailed Deer, disturbance caused by feral Pigs, silviculture, and logging. Most known subpopulations occur in protected areas, but the overwhelming majority of available habitat occurs on private land. Due to the species' restricted range and habitat decline inferred from known threats, it is at moderate risk of extinction.

Red List Assessor(s): *Trillium* Working Group 2019 & Meredith, C.R.

NatureServe Global Rank Reviewer(s): Oliver, L.

Refs: 1, 11–14, 29, 48, 49, 54, 55, 57, 59, 69–74, 76, 77, 81, 83–86, 102, 104, 110, 113, 123, 124, 130, 133, 134

Trillium erectum

L.

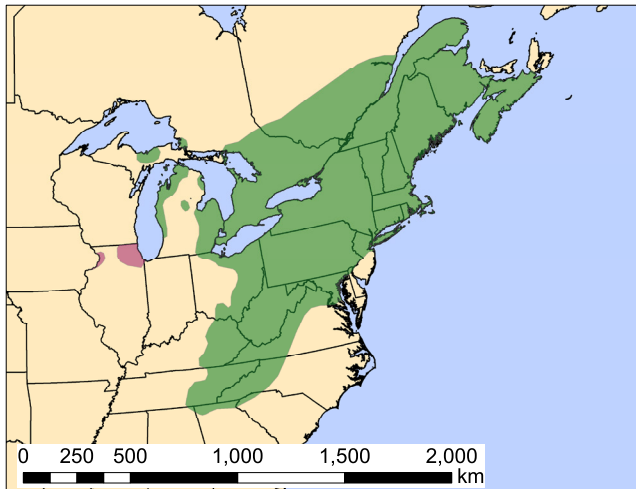
Pedicellate

Least Concern

Secure (G5)

CA: NB, NS, ON, QC

US: AL, CT, DC, DE, GA, IL^U, IN, KY, MA, MD, ME, MI, NC, NH, NJ, NY, OH, PA, RI, SC, TN, VA, VT, WV



Red Trillium (*Trillium erectum*) is widely distributed in the Appalachian mountain range from northern Georgia north to New Brunswick, Nova Scotia, and southern portions of Quebec. The species is also present within the Great Lakes region and occurs in Ohio, throughout the Lower Peninsula of Michigan, portions of southern Ontario, and possibly northern Illinois. It is locally common in favorable, undisturbed habitats. Medicinal preparations including Red *Trillium* are commercially available and demand is thought to be rising. It is widely collected for the medicinal plant trade with most collection occurring in the southern Appalachian Mountains. The species is threatened by habitat degradation from introduced wild Pigs, introduced earthworm species in northern portions of the species' range, herbivory pressure associated with an overabundance of White-tailed Deer, mining, and acid rain. Despite several threats that seriously impact localized subpopulations, the species is extremely widespread and considered to be at low risk of extinction.

Red List Assessor(s): Meredith, C.R. & *Trillium* Working Group 2019

NatureServe Global Rank Reviewer(s): Treher, A.

Refs: 1, 11–13, 24, 25, 48–50, 54, 59, 64, 69, 71–78, 81, 83, 84, 86, 92, 109, 117, 118, 120, 135–144

Trillium flexipes

Raf.

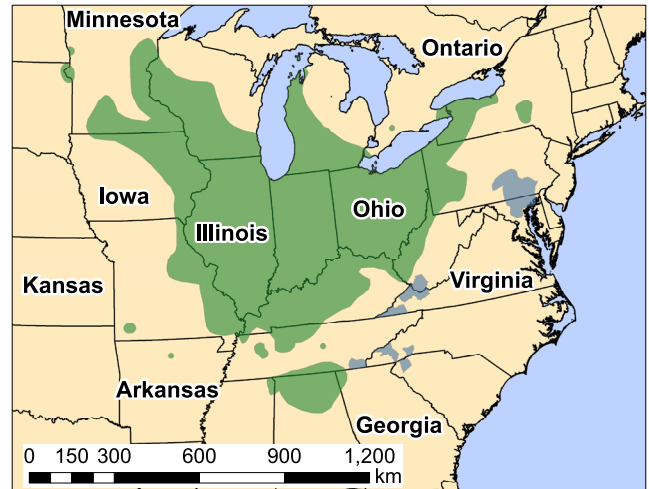
Pedicellate

Least Concern

Secure (G5)

CA: ON

US: AL, AR, GA, IA, IL, IN, KY, MD, MI, MN, MO, MS, NC, NY, OH, PA, SD, TN, VA^H, WV, WI



Drooping Trillium (*Trillium flexipes*) occurs from northern Alabama north to northeastern South Dakota, and New York. Isolated occurrences can also be found in the Piedmont region east of the Appalachian Mountains, notably in Pennsylvania, Maryland, and North Carolina. The species' population is inferred to be large but may be declining due to herbivory pressure from overabundant White-tailed Deer. Other threats to the species include habitat disturbance caused by feral Pigs, and competition with non-native plants including Winter Creeper and Garlic Mustard. This species prefers calcareous soils and occurs on wooded slopes and floodplains under deciduous tree canopies. Because of its large range and inferred large population, the species is not considered to be at substantial risk of extinction in the foreseeable future. However, given the declines noted in portions of its range, additional population monitoring should be conducted.

Red List Assessor(s): Meredith, C.R. & *Trillium* Working Group 2019

NatureServe Global Rank Reviewer(s): Frances, A.

Refs: 1, 11, 13, 14, 24, 32, 48, 49, 54, 57, 59, 64, 69, 71–74, 76, 77, 81, 83, 84, 86, 91, 92, 102, 108, 113, 131, 145–148

Trillium foetidissimum

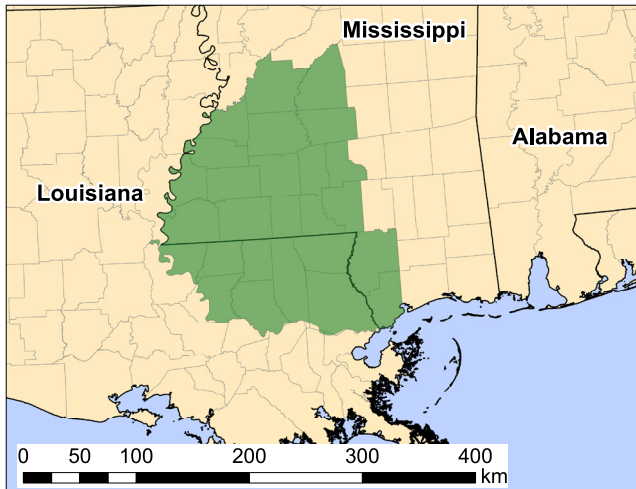
J.D.Freeman

Sessile

Least Concern

US: LA, MS

Vulnerable (G3)



Mississippi River Trillium (*Trillium foetidissimum*) occurs in southeastern Louisiana, and southwestern Mississippi. The species is described as locally abundant in the Upper Coastal Plain within its range, but the population is thought to be declining. It occurs on slopes adjacent to riparian areas on loess soils in hardwood forests, and in association with azaleas (*Rhododendron spp.*). It is tolerant of a wide range of soil moistures and can be found in drier, upland areas in addition to riparian areas. The primary threats impacting Mississippi River Trillium are habitat loss and degradation due to logging, silviculture, and urban sprawl. Habitat degradation caused by feral Pigs and introduced competing plants, namely Chinese Privet, likely threaten some subpopulations. Given the species' restricted range, and the presence of several threats, the species is vulnerable to population declines that may threaten its long-term survival. Additional monitoring is recommended to better determine the population trend of this species.

Red List Assessor(s): Meredith, C.R. & *Trillium* Working Group 2019

NatureServe Global Rank Reviewer(s): Treher, A.

Refs: 1, 11–13, 15, 29, 32, 48, 49, 54, 55, 59, 69, 71–74, 76, 81, 83, 84, 86, 101, 110, 113, 124, 133, 149, 150

Trillium georgianum

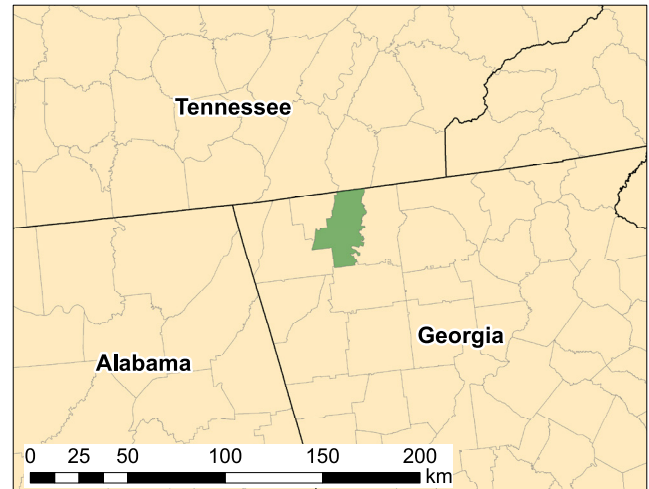
S.B. Farmer

Pedicellate

Critically Endangered B1ab(iii,v)+2ab(iii,v)

Critically Imperiled (G1)

US: GA



Georgia Dwarf Trillium (*Trillium georgianum*) is endemic to Whitfield County, Georgia where it is known from only a single location occurring within the drainage of Swamp Creek, a tributary of the Conasauga River. Previously considered to be a variety of *T. pusillum*, *T. georgianum* was published as a distinct species in 2017. Little is known about the species' habitat and ecology, although it primarily reproduces vegetatively, an unusual trait within the genus. Its habitat is characterized by seasonally wet, shallow depressions. Within these depressions it is found on small, mounded islets on expansive clay soils in association with Red Maple (*Acer rubrum*), Green Ash (*Fraxinus pennsylvanica*), Black Gum (*Nyssa sylvatica*), and Oaks (*Quercus spp.*). The species is threatened by construction associated with industrial development, occurs in a single location, and has an extremely restricted range. It is at a very substantial risk of extinction, and protective measures are urgently needed to ensure the species' survival.

Red List Assessor(s): Meredith, C.R. & *Trillium* Working Group 2019

NatureServe Global Rank Reviewer(s): Treher, A.

Refs: 1, 11, 25, 48, 57, 58, 69, 71–74, 76, 81, 83–86, 109, 151

Trillium gracile

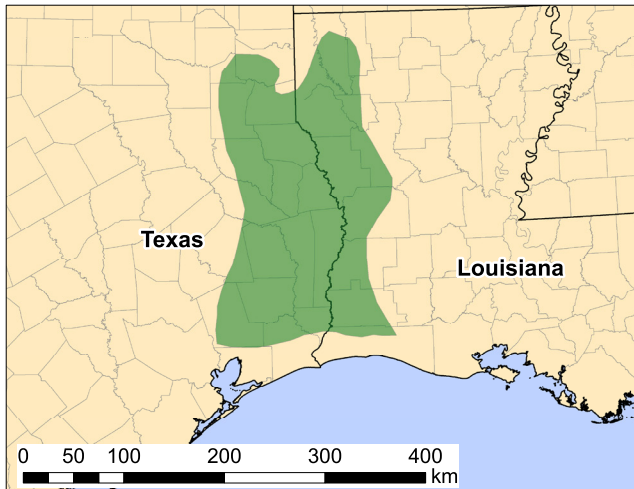
J.D.Freeman

Sessile

Near Threatened B2b(iii)

US: LA, TX

Imperiled (G2G3)



Slender Trillium (*Trillium gracile*) occurs on the Gulf Coast Plain of Louisiana and Texas in the Sabine River drainage. The species has a small range and a relatively restricted habitat type, occurring in mature, relatively open, hardwood pine and mixed deciduous forests, often on banks and ridges in sandy soils. Slender Trillium is occasionally planted as an ornamental. The primary threats to the species are logging, silviculture, and land use changes associated with expansion of urban areas. Remaining forests within the species' range are highly fragmented by rights of way, pastureland, and urban development; a pattern that has increased in recent years. The species is likely undergoing population declines associated with habitat loss and degradation.

Red List Assessor(s): Meredith, C.R. & *Trillium* Working Group 2019

NatureServe Global Rank Reviewer(s): Treher, A. & Frances, A.

Refs: 1, 11, 13, 15, 29, 32, 48, 49, 54, 55, 57, 59, 64, 69, 71–74, 76, 77, 81, 83, 84, 86, 101, 110, 113, 152, 153

Trillium grandiflorum

(Michx.) Salisb.

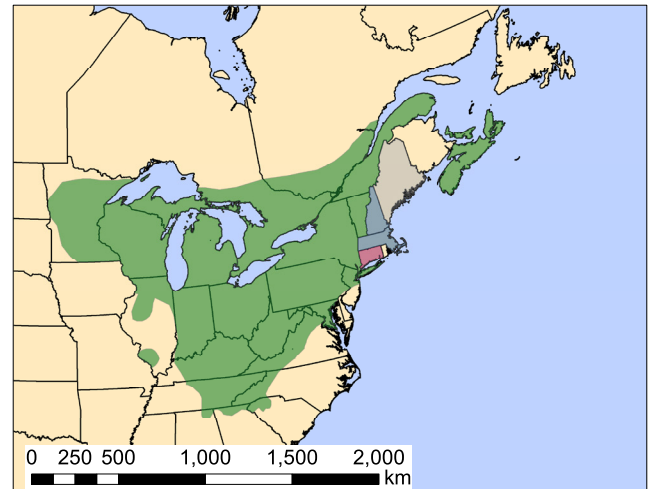
Pedicellate

Least Concern

CA: NB^U, NS, ON, QC

US: AL, CT^U, DC, GA, IL, IN, KY, MA¹, MD, ME^{UH}, MI, MN, NC, NH^U, NJ, NY, OH, PA, SC, TN, VA, VT, WI, WV

Secure (G5)



White Trillium (*Trillium grandiflorum*) occurs from southern Canada to the southern Appalachian Mountains and is abundant in preferred habitats. The root of the plant is used for various medical applications, though intensity of collection is not well understood. Widespread population declines attributable to herbivory pressure associated with an overabundance of White-tailed Deer have been noted in northern portions of the species' distribution and are inferred to be present in southern portions. Inferring the population trend to the entire species' range from observed decline in subpopulations, suggests rapid and substantial decline. It is important to note, however, that the impact of herbivory pressure is not necessarily permanent, nor are the observed rates of decline stable or consistent across the species' range. The transition of flowering, reproductive individuals to non-reproductive stage classes fluctuates over time depending on resources and threats, and this modulation could mitigate overall predation pressure. For these reasons, along with the expansive range of the species and its large population, the species is not considered to be at risk of extinction.

Red List Assessor(s): Meredith, C.R. & *Trillium* Working Group 2019

NatureServe Global Rank Reviewer(s): Oliver, L.

Refs: 1, 11–13, 25, 26, 28, 30, 32, 48–50, 54, 57, 64, 69, 71–74, 76, 78, 81, 83, 84, 86, 91, 92, 107, 113, 120, 135, 148, 154, 155

Trillium kurabayashii

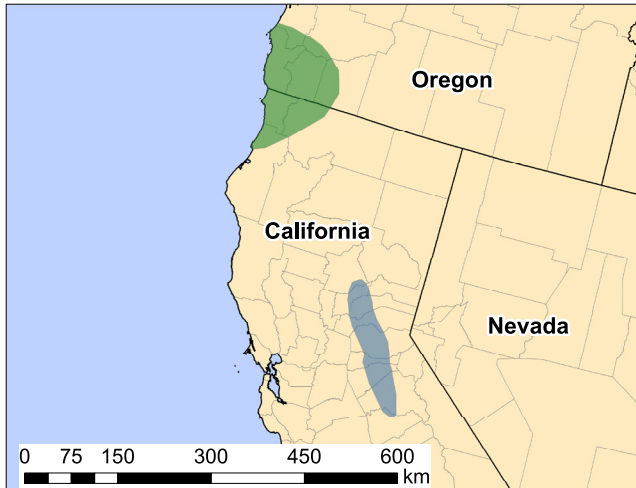
J.D.Freeman

Sessile

Vulnerable D1

US: CA, OR

Vulnerable (G3)



Giant Purple Trillium (*Trillium kurabayashii*) occurs in the Klamath and Coast Ranges of northern California and southwestern Oregon, in two distinct subpopulations. It occurs in a variety of forest types including moist conifer-hardwoods and deciduous flat woods along streams. The species is occasionally planted as an ornamental, with some nurseries indicating propagation from wild collected seeds. The impact of collection on wild subpopulations is unknown. Little is known about threats to the species, but logging, suppression of natural fire regimes, predation by Elk, and competition with invasive plants including Himalayan Blackberry are likely to impact the species. The population size is estimated to be between 1,000 and 3,000 individuals, and may be closer to the lower limit if based on the number of reproductive individuals. More research is needed on distribution, population size and trend, habitats and ecology, and threats. Specifically, the population in the Sierra Nevada Mountains requires further study to determine its taxonomic status. It is considered to be at moderate risk of extinction.

Red List Assessor(s): Wayman, K.A., Meredith, C.R. & *Trillium* Working Group 2019

NatureServe Global Rank Reviewer(s): Oliver, L. & Wayman, K.

Refs: 1, 11, 12, 15, 42, 48, 49, 54–57, 59, 61, 66, 69, 71–74, 76, 83, 84, 86, 91–93, 101, 110, 156–159

Trillium lancifolium

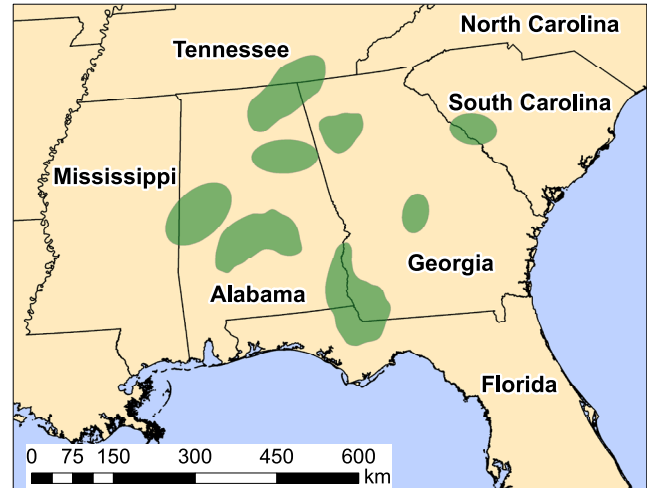
Raf.

Sessile

Endangered B2ab(iii,v)*

US: AL, FL, GA, MS, SC, TN

Vulnerable (G3)



Narrow-leaved Trillium (*Trillium lancifolium*) occurs in disjunct subpopulations that extend from northwest Florida through eastern Tennessee. The species occurs over a wide range but is severely fragmented and occupies a very small area. Narrow-leaved *Trillium* is threatened by herbivory from an overabundance of White-tailed Deer, habitat degradation caused by feral Pigs, and logging operations throughout its range. Given its small range and abundance, severely fragmented population, and inferred declines in both habitat quality and number of mature individuals, the species is at moderate to high risk of extinction. The isolated nature of the species is well suited for habitat protection measures, which may be necessary to protect existing subpopulations from further habitat degradation.

*The Red List includes *T. tennesseense* as a synonym of *T. lancifolium* while NatureServe considers the two taxa as distinct species. Both taxa are presented here separately in the narrowest sense.

Red List Assessor(s): Meredith, C.R. & *Trillium* Working Group 2019

NatureServe Global Rank Reviewer(s): Treher, A. & Frances, A.

Refs: 1, 11–15, 25, 32, 48, 49, 54, 55, 57, 59, 69, 71–74, 76, 77, 81–86, 101, 104, 108, 113, 130, 131, 134, 160–162

Trillium ludovicianum

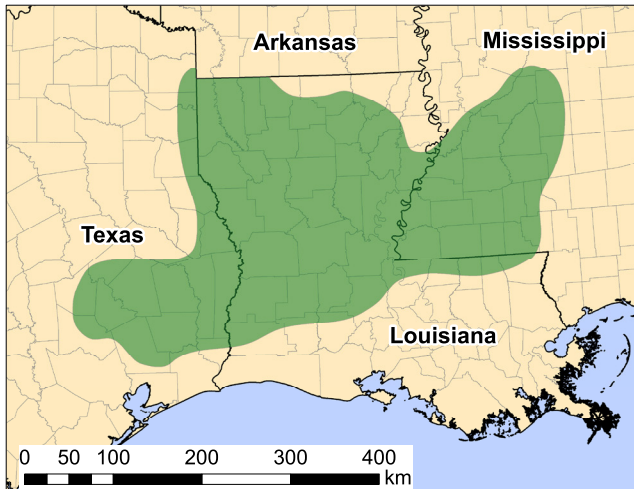
Harb.

Sessile

Least Concern

US: LA, MS, TX

Apparently Secure (G4)



Louisiana Trillium (*Trillium ludovicianum*) occurs in northern Louisiana and limited adjacent portions of Mississippi and Texas. It occurs in floodplains, streambanks, and ravine forests in low-lying moist areas in mixed pine-beech forests. The species is locally abundant, but is threatened by habitat loss associated with development, herbivory from overabundant White-tailed Deer, and habitat degradation from feral Pigs. The population trend for the species is unknown. Due to the relatively large distribution of the species, and presumed large population, the species is at low risk of extinction.

Red List Assessor(s): Meredith, C.R. & *Trillium* Working Group 2019

NatureServe Global Rank Reviewer(s): Treher, A. & Frances, A.

Refs: 1, 11–15, 29, 32, 48, 49, 55, 57, 59, 69, 71–74, 76, 77, 81, 83, 84, 86, 101, 110, 113, 124, 150, 163

Trillium luteum

(Muhl.) Harb.

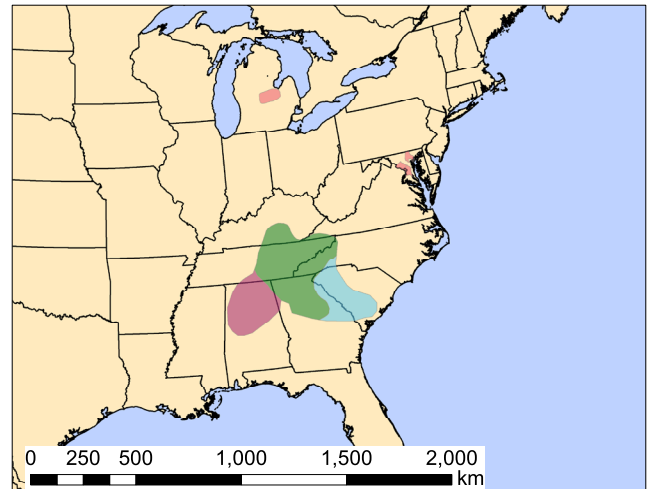
Sessile

Least Concern

CA: ONI

US: AL^U, DC^I, GA, KY, MD^I, MI^I, NC, SC^U, TN, VA^I

Apparently Secure (G4)



The native range of Yellow Trillium (*Trillium luteum*) is in the southern Appalachian Mountains, from northern Georgia through eastern Tennessee and western North Carolina as well as portions of southern Kentucky. It has escaped from cultivation and become established in Michigan and Ontario, and is considered not native to Virginia, Maryland, and several other states. The species is described as abundant in the Ridge and Valley Province and locally abundant in the vicinity of Great Smoky Mountains National Park, particularly near Gatlinburg, Tennessee. It can tolerate disturbance and its population is thought to be stable. It occurs in deciduous forests, in thin open woods, clearings, old fields, riparian areas, and mature forests, typically on rocky calcareous or granitic substrates. The species is threatened by logging and land conversion, habitat disturbance caused by feral Pigs, and excessive herbivory from overabundant White-tailed Deer. Among the sessile *Trillium* species, Yellow Trillium is the most widely cultivated species. Most horticultural specimens are collected from the wild. Given its moderately large range and inferred large population, the species is thought to have a low extinction risk.

Red List Assessor(s): Meredith, C.R. & *Trillium* Working Group 2019

NatureServe Global Rank Reviewer(s): Frances, A.

Refs: 1, 11, 12, 14, 32, 48, 49, 54, 55, 57, 59, 64, 69, 71–74, 76, 83, 84, 86, 101, 104, 108, 110, 113, 164–166

Trillium maculatum

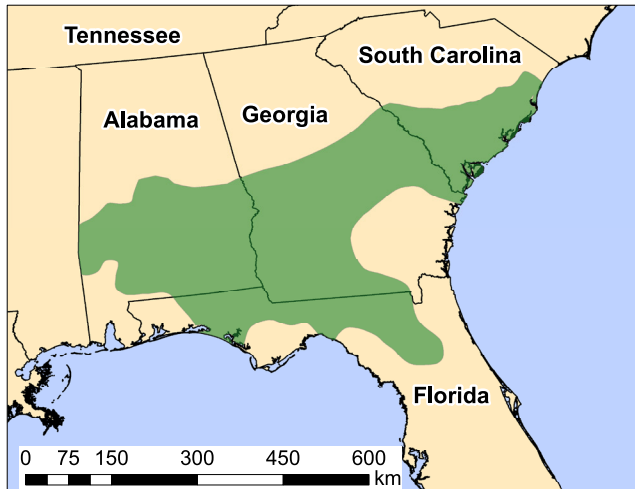
Raf.

Sessile

Data Deficient

Apparently Secure (G4)

US: AL, FL, GA, SC



Spotted Trillium (*Trillium maculatum*) occurs in the Upper Coastal Plain and Piedmont regions from Alabama, and northern Florida to Georgia, and South Carolina. It occurs on granitic and calcareous substrates including coquina limestone, and shell middens in rich mesic woodlands. The species is very long lived and susceptible to population declines over time; however, the species' population is still inferred to be large. Spotted Trillium is threatened by herbivory from overabundant White-tailed Deer and competition with competing invasive species including Chinese Privet. Browsing by expanding White-tailed Deer populations is suspected to be causing long-term declines in population throughout the species' range, but additional research is needed to quantify these declines. Because the declines in the species are poorly understood, and that this species may qualify for a more threatened status based on these population declines, it is currently assessed as Data Deficient by the Red List. Due to its relatively large range and moderate threat level, it is considered Apparently Secure by NatureServe.

Red List Assessor(s): Meredith, C.R. & *Trillium* Working Group 2019

NatureServe Global Rank Reviewer(s): Treher, A.

Refs: 1, 11, 13–15, 32, 48, 49, 54, 55, 57, 59, 69, 71–74, 76, 81, 83, 84, 86, 101, 104, 108, 110, 113, 163, 167

Trillium nivale

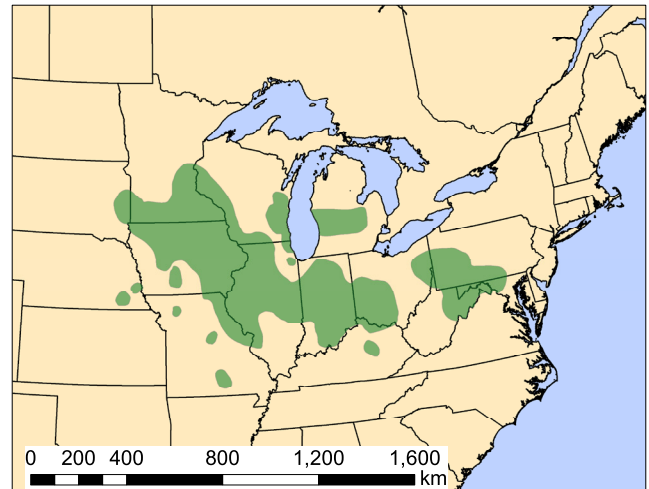
Riddell

Pedicellate

Least Concern

Apparently Secure (G4)

US: IL, IN, IA, KY, MD, MI, MN, MO, NE, OH, PA, SD, VA, WI, WV



Snow Trillium (*Trillium nivale*) has a broad distribution ranging from Maryland to South Dakota and from Missouri to Minnesota, but is rare or infrequent throughout much of its range. The species is among the earliest to bloom in spring. It occurs in calcareous, rocky soils often associated with limestone crevices, gravel deposits, sandy river terraces, and cliff bases. The species grows best in areas with little leaf litter, and very little competition with other herbaceous species. It may be threatened by habitat loss, and herbivory associated with overabundance of White-tailed Deer. Though its population trend is uncertain, very large subpopulations persist in portions of the species' range and the species is thought to be at relatively low risk of extinction.

Red List Assessor(s): Meredith, C.R. & *Trillium* Working Group 2019

NatureServe Global Rank Reviewer(s): Oliver, L. & Frances, A.

Refs: 1, 11–13, 25, 26, 32, 48, 49, 54, 55, 57, 59, 69, 71–74, 76, 81, 83, 84, 86, 107, 110, 113, 142, 168–180

Trillium oostingii

Gaddy

Sessile

Endangered B1ab(v)+2ab(v)

Critically Imperiled (G1)

US: SC



Waterree Trillium (*Trillium oostingii*) is known only from Kershaw and Richland Counties, South Carolina. Twenty occurrences are known southwest of Camden, South Carolina and along the Waterree River, at elevations ranging from 50 to 100 meters. It occurs in four subpopulations on nutrient rich floodplains, levees, and flats along the Waterree River and is locally abundant with thousands of stems described in some occurrences. The species is rarely available as an ornamental, and collection for the ornamental trade has occurred, but the impact of such collection is thought to be minor. Rooting from feral Pigs and erosion along levee banks have caused slight population declines. Other potential threats to the species include herbivory from overabundant White-tailed Deer, and competition with invasive Chinese Privet. Portions of the species' habitat are protected, but additional population monitoring is needed to better conserve the species. Due to its very restricted range, presence in only four locations, and continuing population decline, the species is at high risk of extinction.

Red List Assessor(s): Meredith, C.R., *Trillium* Working Group 2019, Farmer, S.B. & Gaddy, L.L.

NatureServe Global Rank Reviewer(s): Treher, A. & Frances, A.

Refs: 1, 11, 32, 48, 49, 54, 55, 57, 69, 71–74, 76, 81, 83, 84, 86, 113, 181, 182

Trillium ovatum

Pursh

Pedicellate

Least Concern

Secure (G5)*

CA: AB, BC

US: CO, CA, ID, MT, OR, WA, WY

Pacific Trillium (*Trillium ovatum*) is a species complex, with recent evidence indicating it includes five distinct species. Given the current uncertain status of taxa formerly recognized as infraspecies of *T. ovatum*, these taxa are presented here as a species complex. In addition to *T. ovatum*, the complex includes *T. crassifolium*, *T. hibbersonii*, and *T. scouleri*, which NatureServe recognizes at the species level, and are treated as such in this booklet. The Red List treats these four taxa within *T. ovatum* but includes an analysis documenting the impact of future taxonomic changes which is presented here. In the narrowed sense, *T. ovatum* can be further subdivided into *T. ovatum* subsp. *ovatum* and *T. ovatum* subsp. *oettingeri*. Accounts for these concepts are also included below. *Trillium ovatum sensu lato* is not considered to be at risk of extinction.

Red List Assessor(s): Meredith, C.R., Schilling, E.E. & *Trillium* Working Group 2019

NatureServe Global Rank Reviewer(s): Oliver, L.

Refs: 1, 11, 13, 42, 46, 48, 49, 54, 55, 57, 59–61, 66, 67, 69, 71–74, 76, 83, 84, 86, 91–93, 120, 156, 157, 183–192

NatureServe		Red List Proposed	Red List as Published
<i>Trillium ovatum</i>	subsp. <i>ovatum</i>	subsp. <i>ovatum</i>	<i>Trillium ovatum</i>
	subsp. <i>oettingeri</i>	subsp. <i>oettingeri</i>	
<i>Trillium crassifolium</i>		<i>Trillium crassifolium</i>	
<i>Trillium hibbersonii</i>		<i>Trillium hibbersonii</i>	
<i>Trillium scouleri</i>		<i>Trillium scouleri</i>	

Table 4: Comparison of taxonomic distinctions recognized by NatureServe and the Red List.

Trillium crassifolium

Piper

Pedicellate

Data Deficient*

US: WA

Critically Imperiled (G1G2)



Trillium crassifolium was described in the late 1800s, but was treated as part of *T. ovatum*. Recent molecular work has revealed that the older interpretation of *crassifolium* as a distinct species is accurate. It is endemic to the Wenatchee Mountains of central Washington. Very little is known about this taxon, including the extent of its range, threats, and population size. It is considered to be at high risk of extinction.

*The Red List includes *Trillium crassifolium* as a synonym of *Trillium ovatum* Pursh

Red List Assessor(s): Meredith, C.R., Schilling, E. & *Trillium* Working Group 2019

NatureServe Global Rank Reviewer(s): Oliver, L. & Wayman, K.A.

Refs: 1, 11, 13, 42, 46, 48, 49, 54, 55, 57, 59–61, 66, 67, 69, 71–74, 76, 83, 84, 86, 91–93, 120, 156, 157, 185–192

Trillium hibbersonii

(T.M.C. Taylor & Szczaw.) D. O'Neill & S.B. Farmer

Pedicellate

Endangered B2ab(iii)*

CA: BC

Vulnerable (G3)



Hibberson's *Trillium* (*Trillium hibbersonii*) was treated as variety of *T. ovatum* until recently but was published as a species in 2020. It has a very limited range, with known occurrences in only four remote and inaccessible areas on the Pacific Coast of Vancouver Island, British Columbia. It is threatened by logging in adjacent areas. Climate change that would affect the hydrology of the seep habitats where it occurs is also considered a threat. Given its very limited distribution, small number of known occurrences, and the threats to the taxon, notably from logging, it is at a moderate risk of extinction.

*The Red List includes *Trillium hibbersonii* as a synonym of *Trillium ovatum* Pursh

Red List Assessor(s): Meredith, C.R., Schilling, E.E. & *Trillium* Working Group 2019

NatureServe Global Rank Reviewer(s): Penny, J. & Oliver, L.

Refs: 1, 11, 13, 42, 46, 48, 49, 54, 55, 57, 59–61, 66, 67, 69, 71–74, 76, 83, 84, 86, 87, 91–93, 120, 156, 157, 185–192

Trillium ovatum var. *oettingeri*

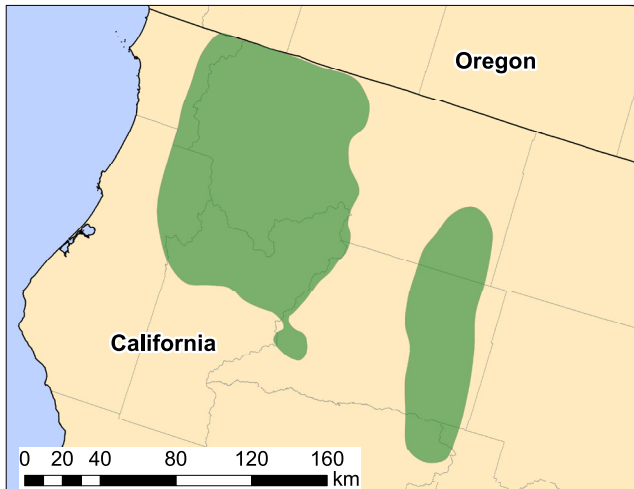
Munz & Thorne

Pedicellate

Data Deficient*

US: CA

Apparently Secure (T4)



Trillium ovatum var. *oettingeri* is endemic to northern California and occurs entirely in protected areas. It is found within the Klamath and Shasta-Trinity National Forests. Wildfires have impacted some areas and perhaps caused substantial population declines. With that said, the subpopulations are protected from logging and other disturbances. The taxon is considered to be at relatively low risk of extinction.

*The Red List includes *Trillium ovatum* var. *oettingeri* as a synonym of *Trillium ovatum* Pursh

Red List Assessor(s): Meredith, C.R., Schilling, E.E. & *Trillium* Working Group 2019

NatureServe Global Rank Reviewer(s): Oliver, L., Wayman, K., & Treher, A.

Refs: 1, 11, 13, 42, 46, 48, 49, 54, 55, 57, 59–61, 66, 67, 69, 71–74, 76, 83, 84, 86, 91–93, 93, 120, 156, 157, 185–193

Trillium ovatum var. *ovatum*

Pursh.

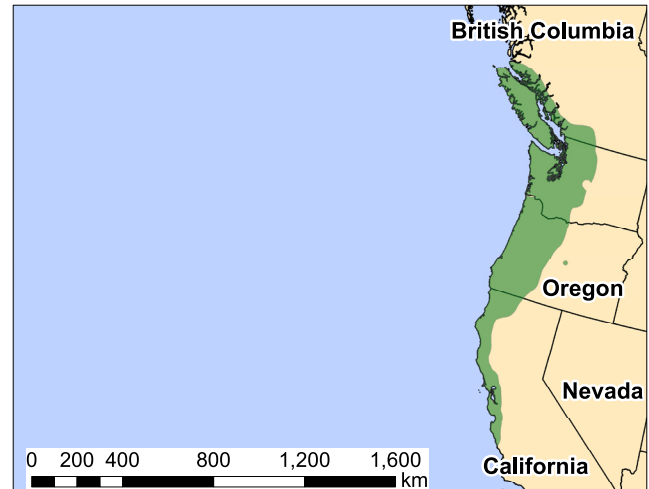
Pedicellate

Least Concern*

CA: BC

US: CA, OR, WA

Secure (T5)



Trillium ovatum var. *ovatum* occurs from British Columbia through Washington, Oregon, and California within mountainous areas along the coast. The species often occurs in association with Douglas-fir (*Pseudotsuga menziesii*) but may also be found in forests dominated by Western Red Cedar (*Thuja plicata*), Western Hemlock (*Tsuga heterophylla*), Bigleaf Maple (*Acer macrophyllum*), Red Alder (*Alnus rubra*), and Sitka Spruce (*Picea sitchensis*). The root of the plant has been used to treat sore eyes by the Lummi, Paiute, Skagit, and Thompson. The taxon is intolerant of logging and may require centuries to recover from clearcutting. Observed rates of decline in some subpopulations exceed 95% to clearcutting. Despite the threat posed by logging, the species has a robust population in California and is unlikely to be at risk of extinction.

*The Red List includes *Trillium ovatum sensu stricto* as a synonym of *Trillium ovatum* Pursh

Red List Assessor(s): Meredith, C.R., Schilling, E.E. & *Trillium* Working Group 2019

NatureServe Global Rank Reviewer(s): Oliver, L.

Refs: 11, 13, 42, 46, 54, 55, 59–61, 66, 67, 91–93, 120, 156, 157, 185–192

Trillium scouleri

Rydb. ex Gleason

Pedicellate

Least Concern*

Apparently Secure (G4G5)

CA: AB, BC

US: CO, ID, MT, OR, WA, WY



The taxonomic status of *Trillium scouleri* is unclear, however, it was historically recognized at the species level and recent genetic evidence suggests this interpretation is likely to be revisited. It occurs in the Northern Rocky Mountains from the Thompson Plateau of British Columbia, south through easternmost Washington and Oregon, extending nearly to the Snake River Plain in Idaho, and including the mountains of westernmost Montana. Disjunct subpopulations also occur in the Absaroka, Beartooth, and Gallatin Ranges of Montana and Wyoming, and in the Park Range of Colorado and Wyoming. Population trend, habitats, and the threats to the species are poorly documented, but the species occurs across a broad range in many remote, protected areas. As such, it is considered to have a low risk of extinction.

*The Red List includes *Trillium scouleri* as a synonym of *Trillium ovatum* Pursh

Red List Assessor(s): Meredith, C.R., Schilling, E.E. & *Trillium* Working Group 2019

NatureServe Global Rank Reviewer(s): Oliver, L.

Refs: 1, 11, 13, 42, 46, 48, 49, 54, 55, 57, 59–61, 66, 67, 69, 71–74, 76, 83, 84, 86, 91–93, 120, 156, 157, 184–192

Trillium persistens

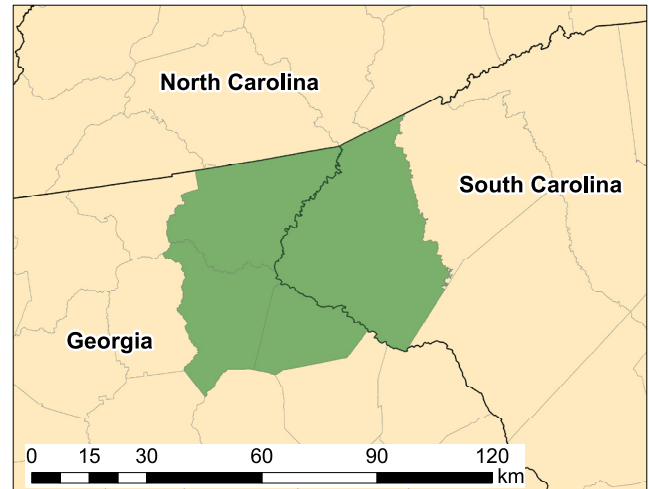
Duncan

Pedicellate

Vulnerable D2

Critically Imperiled (G1)

US: GA, SC



Persistent Trillium (*Trillium persistens*) is found only in and around Tallulah Gorge in Habersham, Rabun, and Stephens Counties, Georgia and Oconee County, South Carolina. The species inhabits steep slopes under mixed-deciduous forest canopies. Although additional population surveys are needed to determine current population size and trends, the species is thought to have a relatively stable population of approximately 20,000 stems. The species was previously threatened by habitat degradation caused by logging and recreational usage, however, most of these threats have been mitigated and the species is considered well protected. Given the species' extremely restricted range, it is still susceptible to stochastic events or substantial alterations of its limited habitat. Ongoing habitat quality decline caused by the Hemlock Woolly Adelgid may impact the entire population. Because it has a very restricted distribution and is subject to a potential threat that could cause rapid population declines, it is considered to be at a moderate to high risk of extinction.

Red List Assessor(s): Meredith, C.R. & *Trillium* Working Group 2019

NatureServe Global Rank Reviewer(s): Treher, A. & Frances, A.

Refs: 1, 11, 12, 25, 48, 49, 55, 57, 69, 71–74, 76, 83, 84, 86, 113, 131, 138, 194–199

Trillium petiolatum

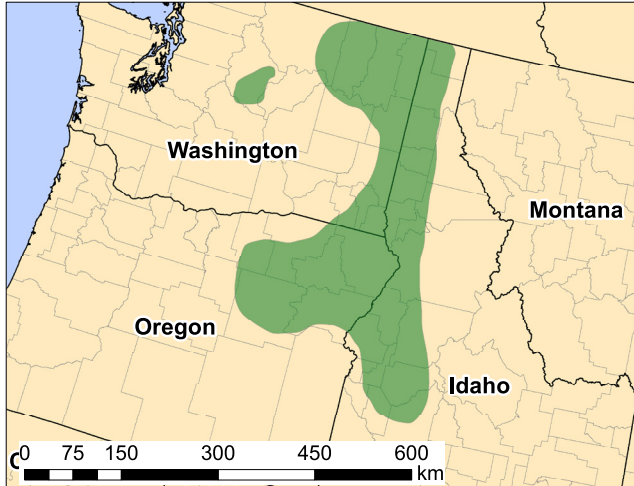
Pursh

Sessile

Least Concern

US: ID, OR, WA

Apparently Secure (G4)



Idaho Trillium (*Trillium petiolatum*) occurs in northern Idaho and eastern Oregon and Washington. Found in association with a variety of forest types, it is tolerant of more xeric conditions than other western *Trillium* species. Population size and trends are not well understood and research is needed to better understand the threats and related population dynamics. Despite these uncertainties, the species has a relatively large range and is noted to be locally abundant in areas with favorable habitat. Given its wide range and absence of specific threats, the species is listed at a low risk of extinction.

Red List Assessor(s): Meredith, C.R., Wayman, K.A. & *Trillium* Working Group 2019

NatureServe Global Rank Reviewer(s): Oliver, L. & Wayman, K.

Refs: 1, 11, 13, 48, 49, 54, 55, 57, 61, 68, 69, 71–74, 76, 83, 84, 86, 91–93, 120, 200

Trillium pusillum

Pursh

Pedicellate

Least Concern

US: AL, AR, GA, KY, MD, MO, MS, NC, OK, SC, TN, VA, WV

Apparently Secure (G4)

Dwarf Trillium (*Trillium pusillum*) occurs in the southeastern United States and has a widely disjunct distribution comprised of highly variable regional subpopulations. Research is underway to investigate the distribution patterns and taxonomy of the *T. pusillum* species complex and the conservation status of infraspecies within the complex is highly dependent on the outcome of this research. The assessments presented here follow the numbering system employed by Weakley. Future research may validate recognition of these varieties at the species rank. Two taxa formerly considered part of *T. pusillum* (*T. texanum* and *T. georgianum*) are treated in this text at the species level and are listed elsewhere in this volume.

The species complex can be divided into three clusters. The Virginianum Cluster consists of published varieties *monticulum* and *virginianum*. Two additional taxa, variety 4 and variety 5, will likely be split from variety *virginianum* when formally published. The Ozarkanum Cluster is composed of the published variety *ozarkanum*, from which the putative variety 1 will likely be split. The Pusillum Cluster is composed of variety *pusillum* and the putative variety 3.

Considered as a species complex (and excepting *T. texanum* and *T. georgianum*), Dwarf Trillium is at low risk of extinction. The combined ranges of its constituent varieties extend from West Virginia south to South Carolina and west to Oklahoma. Its habitats and major threats are quite varied (as described below), but aggregate populations are robust.

Red List Assessor(s): Meredith, C.R., Schilling, E.E. & *Trillium* Working Group 2019

NatureServe Global Rank Reviewer(s): Oliver, L.

Refs: 1, 11–15, 24, 25, 30, 33, 48, 49, 55, 57, 69, 71–74, 76, 81, 83–86, 91, 92, 102, 122, 131, 138, 141, 164, 173, 201–217

NatureServe	Farmer/Red List Proposed/Weakley	Red List as Published	
<i>Trillium pusillum</i> var. <i>ozarkanum</i>	<i>Trillium</i> 'ozarkanum' (= <i>T. pusillum</i> var. <i>ozarkanum</i>)	<i>Trillium pusillum</i>	
	<i>Trillium</i> 'alabamicum' (= <i>T. pusillum</i> var. 1)		
<i>Trillium pusillum</i> var. <i>virginianum</i>	<i>Trillium virginianum</i>		
	<i>Trillium</i> 'carolinianum' (= <i>T. pusillum</i> var. 4)		
	<i>Trillium</i> 'palustris' (= <i>T. pusillum</i> var. 5)		
<i>Trillium pusillum</i> var. <i>monticulum</i>	<i>Trillium</i> 'monticulum' (= <i>T. pusillum</i> var. <i>monticulum</i>)		
<i>Trillium pusillum</i> var. <i>pusillum</i>	<i>Trillium pusillum</i> (= <i>T. pusillum</i> var. <i>pusillum</i>)		
	<i>Trillium</i> 'telmacola' (= <i>T. pusillum</i> var. 3)		
<i>Trillium georgianum</i>	<i>Trillium georgianum</i>		<i>Trillium georgianum</i>
<i>Trillium texanum</i>	<i>Trillium texanum</i>		<i>Trillium texanum</i>

Table 5: Comparison of *T. pusillum* taxonomic frameworks recognized by NatureServe and the Red List.

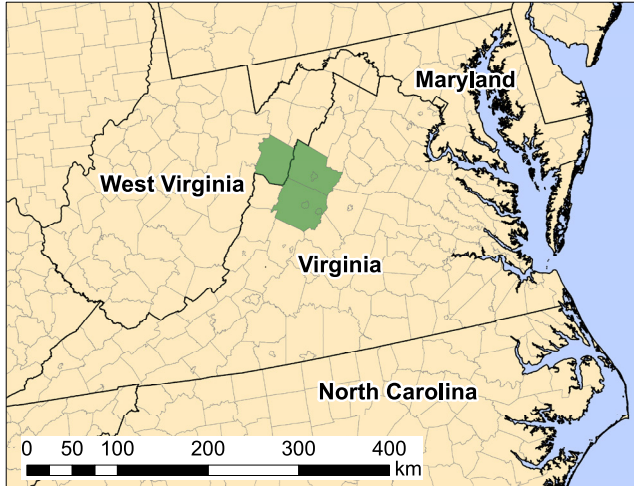
Trillium pusillum var. *monticulum*

Bodkin & Reveal

Pedicellate

Endangered B1ab(iii)+2ab(iii)* Imperiled (G4T2)

US: VA, WV



Trillium pusillum var. *monticulum* is part of the Virginianum cluster. It occurs in northwest Virginia in Augusta and Rockingham Counties, and eastern West Virginia, in Pendleton County. The taxon is restricted to ridgelines associated with the crest of Shenandoah Mountains. It is likely that this variety will be elevated to the species level. The taxon is known from only two locations, and recent population data for the species is not available, however, at the time of its description (1982), each subpopulation consisted of 300 stems. It occurs in dry or dry-mesic woodlands, meadow margins, and relatively open areas. Due to its limited distribution and several ongoing threats in the region, the species is considered to be at extremely high risk of extinction.

*The Red List includes *Trillium pusillum* var. *monticulum* under its treatment of *Trillium pusillum*

Red List Assessor(s): Meredith, C.R. & *Trillium* Working Group 2019

NatureServe Global Rank Reviewer(s): Treher, A.

Refs: 1, 11–15, 24, 25, 30, 33, 48, 49, 55, 57, 69, 71–74, 76, 81, 83–86, 91, 92, 102, 138, 141, 164, 201–212

Trillium pusillum var. *virginianum*

Fernald

Pedicellate

Vulnerable B1ab(iii)*

Imperiled (G4T2)†

US: VA



Trillium pusillum var. *virginianum* occurs in swamps only on the upper Coastal Plain of southeastern Virginia and is found from Henrico east to Mathews Counties, and south to Brunswick and Greenville Counties. Fewer than 10,000 individuals are thought to exist in no more than 55 occurrences. Habitat quality for the species continues to decline as a result of competition with invasive species, urban expansion, habitat degradation caused by feral Pigs, and herbivory by overabundant White-tailed Deer. Additional population surveys are needed as several subpopulations have not been observed in more than 30 years. Due to its narrow range and the numerous threats to the taxon, it is considered to be at high risk of extinction.

*The Red List includes *Trillium pusillum* var. *virginianum* under its treatment of *Trillium pusillum*

† This Global Rank is provisional and not available on NatureServe Explorer because the taxon is not formally published.

Red List Assessor(s): Meredith, C.R. & *Trillium* Working Group 2019

NatureServe Global Rank Reviewer(s): Treher, A.

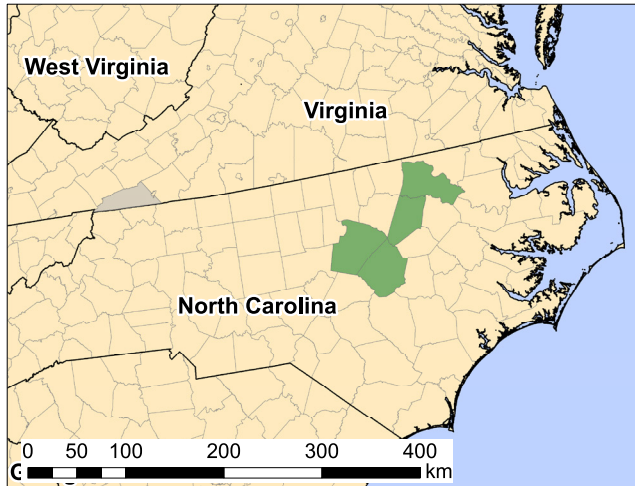
Refs: 1, 11–15, 24, 25, 30, 33, 48, 49, 55, 57, 69, 71–74, 76, 81, 83–86, 91, 92, 102, 138, 141, 164, 201–212

Trillium pusillum var. 4

Pedicellate

Vulnerable B1ab(i,iii,iv,v)* Vulnerable (G4T3)†

US: NC, VA[†]



Carolinian Trillium (*Trillium pusillum* var. 4) occurs primarily along the Fall Line ranging from Johnston to Halifax Counties, North Carolina. A historic subpopulation in Grayson County, Virginia could not be relocated during surveys conducted in 2001. The taxon's population is not well understood, but repeated surveys suggest it is in decline. It occurs in a region undergoing rapid population growth, and may be threatened by habitat loss and competition with introduced plant species. However, the taxon occurs in two protected areas and some subpopulations may be adequately protected. Due to its limited range, the presence of several threats, and the relatively recent loss of a historic subpopulation, the taxon is considered at moderate risk of extinction.

*The Red List includes *Trillium pusillum* var. 4 under its treatment of *Trillium pusillum*.

† This Global Rank is provisional and not available on NatureServe Explorer because the taxon is not formally published.

Red List Assessor(s): Meredith, C.R. & *Trillium* Working Group 2019

Refs: 1, 11–15, 24, 25, 30, 33, 48, 49, 55, 57, 69, 71–74, 76, 81, 83–86, 91, 92, 102, 122, 131, 138, 141, 164, 173, 201–217

Trillium pusillum var. 5

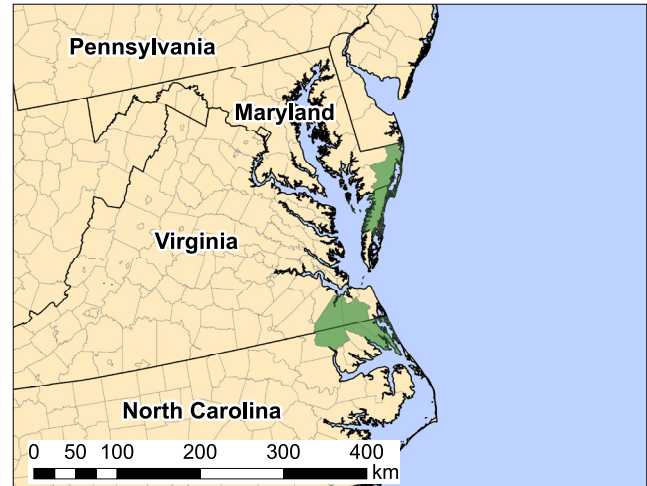
Pedicellate

Vulnerable B1ab(iii)*

Vulnerable (G4T3) †

Vulnerable(G4T3)†

US: MD, NC, VA



Dismal Swamp Least Trillium (*Trillium pusillum* var. 5) occurs in the southernmost portions of the Delmarva Peninsula, and five counties in North Carolina and Virginia in the vicinity of the Great Dismal Swamp. The population of the taxon is poorly understood, but a total of nine occurrences have been documented. It is confined to low-lying wetland habitats making it susceptible to disturbance from feral Pigs. It may also be negatively impacted by forest clearance and wetland drainage. Urban development within counties included in the species' range is among the most rapid in the state of North Carolina, and further development in the region is likely. Due to the species' limited distribution, and the threat of habitat loss and degradation, the species is considered to be at moderate risk of extinction.

*The Red List includes *Trillium pusillum* var. 5 under its treatment of *Trillium pusillum*

† This Global Rank is provisional and not available on NatureServe Explorer because the taxon is not formally published.

Red List Assessor(s): Meredith, C.R. & *Trillium* Working Group 2019

Refs: 1, 11–15, 24, 25, 30, 33, 48, 49, 55, 57, 69, 71–74, 76, 81, 83–86, 91, 92, 102, 122, 131, 138, 141, 164, 173, 201–217

Trillium pusillum var. *ozarkanum*

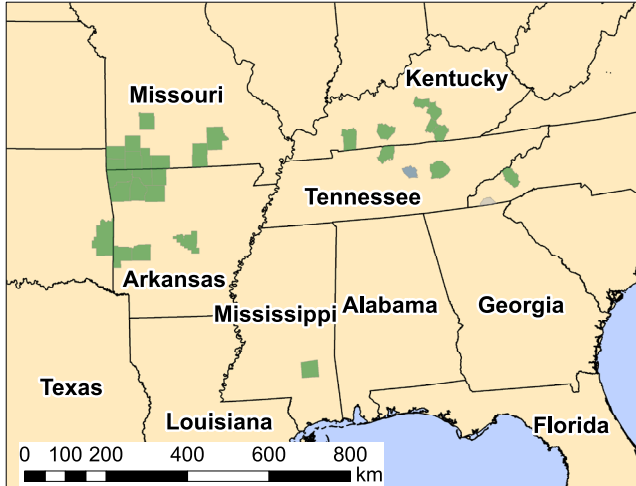
(E.J. Palmer & Steyererm.) Steyererm.

Pedicellate

Least Concern*

US: AR, KY, OK, MO, MS, NC, TN

Vulnerable (G4T3)



Within the *Trillium pusillum* species complex, Ozark Trillium (*Trillium pusillum* var. *ozarkanum*) is the most broadly distributed and abundant member. Though it has been historically considered a variety, it may be elevated to the species level. It occurs in the Ozark Mountains of southwest Missouri, northwest Arkansas, and eastern Oklahoma. Disjunct subpopulations of Ozark Trillium also occur in south central Kentucky, north central Tennessee (Sumner County), and southwest North Carolina (Clay and Haywood Counties), and in Jones County, Mississippi. The putative variety *Trillium pusillum* var. 1 would be split from *Trillium pusillum* var. *ozarkanum* from occurrences in northern Alabama and central Tennessee. These materials have been excluded here in discussions of var. *ozarkanum*. Its habitat requirements are broad, and the taxon occurs in relatively dry areas to wetlands. The primary threats to the taxon are logging and overabundance of White-tailed Deer. Due to its wide range and large population, the taxon is considered to be at low to moderate risk of extinction.

*The Red List includes *Trillium pusillum* var. *ozarkanum* under its treatment of *Trillium pusillum*

Red List Assessor(s): Meredith, C.R. & *Trillium* Working Group 2019

NatureServe Global Rank Reviewer(s): Treher, A.

Refs: 1, 11–15, 24, 25, 30, 33, 48, 49, 55, 57, 69, 71–74, 76, 81, 83–86, 91, 92, 102, 138, 141, 164, 201–212

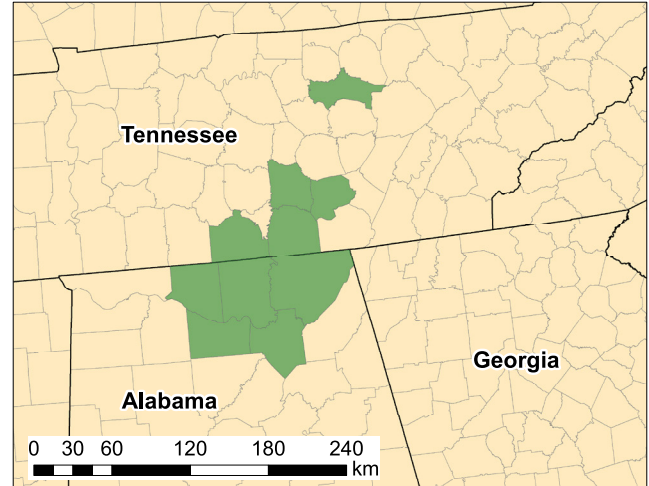
Trillium pusillum var. 1

Pedicellate

Least Concern*

US: AL, TN

Vulnerable (G4T3)†



Alabama Trillium (*Trillium pusillum* var. 1) occurs from Alabama's interior southern highland rim from Marshall and Morgan Counties, north to Tennessee in Putnam County. The taxon is relatively abundant with population estimates suggesting many thousands of adults are present within its range. The taxon is most commonly found in wetland habitats, but has shown considerable flexibility in habitat preference. Population declines may be ongoing as a result of habitat disturbance from feral Pigs and competition with introduced plant species, but these are not thought to present a substantial risk to the taxon as a whole. Its extinction risk is considered low.

*The Red List includes *Trillium pusillum* var. 1 under its treatment of *Trillium pusillum*

† This Global Rank is provisional and not available on NatureServe Explorer because the taxon is not formally published.

Red List Assessor(s): Meredith, C.R. & *Trillium* Working Group 2019

Refs: 1, 11–15, 24, 25, 30, 33, 48, 49, 55, 57, 69, 71–74, 76, 81, 83–86, 91, 92, 102, 122, 131, 138, 141, 164, 173, 201–217

Trillium pusillum var. *pusillum*

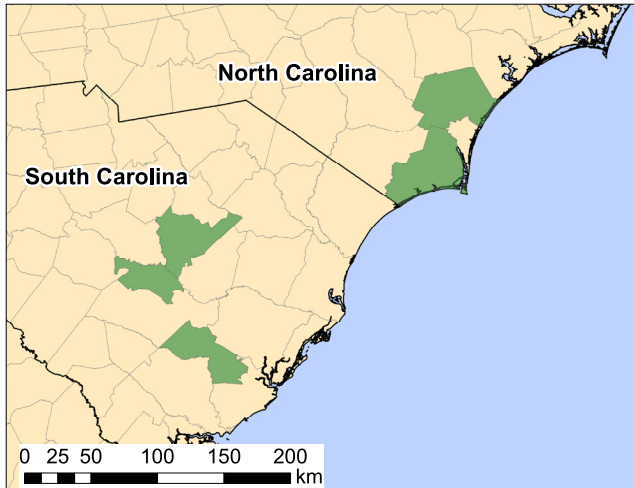
Pursh

Pedicellate

Least Concern*

US: NC, SC

Vulnerable (G4T3)



Dwarf Trillium (*Trillium pusillum* var. *pusillum sensu stricto*) occurs along the Coastal Plain of North Carolina in Brunswick and Pender Counties, and in several counties in South Carolina. Subpopulations in Williamsburg County, South Carolina are extirpated. In the narrowest interpretation, this taxon is thought to have a total population of fewer than 10,000 plants. It occurs in wetland habitats and is threatened primarily by habitat degradation caused by feral Pigs, and reduction of wetland areas caused by surrounding expanding urban areas. The taxon is considered to be at low to moderate risk of extinction. However, given the threats present within its range, and the increasing threat posed by feral Pigs, additional population monitoring may be warranted.

*The Red List includes *Trillium pusillum sensu stricto* under its treatment of *Trillium pusillum*

Red List Assessor(s): Meredith, C.R. & *Trillium* Working Group 2019

NatureServe Global Rank Reviewer(s): Treher, A.

Refs: 1, 11–15, 24, 25, 30, 33, 48, 49, 55, 57, 69, 71–74, 76, 81, 83–86, 91, 92, 102, 138, 141, 164, 201–212, 218, 219

Trillium pusillum var. 3

Pedicellate

Critically Endangered D*

Critically Imperiled (G4T1)†

US: SC



Aiken Least Trillium (*Trillium pusillum* var. 3) occurs in a very narrow distribution on the sand hills of the Savannah River Site on the border of Aiken and Barnwell Counties, South Carolina. The taxon's population is extremely small with an estimated adult population composed of potentially fewer than 50 individuals. It occurs in wetland habitats and has been observed to prostrate itself upon pollination, a trait not noted for any other *Trillium* taxon. The Savannah River Site is noted to host large numbers of feral Pigs and overabundant White-tailed Deer. Habitat disturbance from the former is considered to be the most significant threat to the taxon. Population monitoring of this rare taxon is needed to determine its population trend, but its tendency to prostrate after very brief bloom periods complicates these efforts. Due to its very limited population, the taxon is considered to be at extremely high risk of extinction.

*The Red List includes *Trillium pusillum* var. 3 under its treatment of *Trillium pusillum*

† This Global Rank is provisional and not available on NatureServe Explorer because the taxon is not formally published.

Red List Assessor(s): Meredith, C.R. & *Trillium* Working Group 2019

Refs: 1, 11–15, 24, 25, 30, 33, 48, 49, 55, 57, 69, 71–74, 76, 81, 83–86, 91, 92, 102, 122, 131, 138, 141, 164, 173, 201–217

Trillium recurvatum

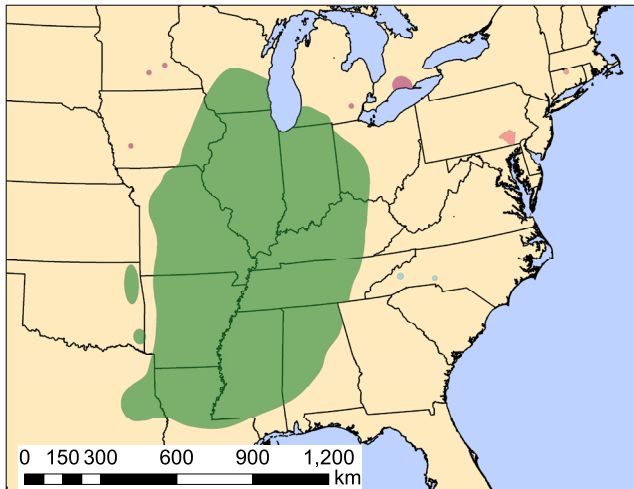
Beck

Sessile

Least Concern

Secure (G5)

US: AL, AR, CT, IL, IN, IA, KY, LA, MI, MO, MS, NC, NE, OH, OK, PA, TN, TX, WI



Prairie Trillium (*Trillium recurvatum*) occurs in the Mississippi River Basin from Alabama and Texas north to Iowa, Wisconsin, and Michigan. The species is relatively abundant within its range and occurs in a variety of forest communities and substrates. Threats to the species include herbivory pressure caused by the overabundance of White-tailed Deer and habitat disturbance associated with logging practices. The species is known to occur in several protected areas within its range. Because the species is abundant, relatively tolerant of habitat disturbance, and lacking evident population declines, it is at a low risk of extinction.

Red List Assessor(s): Meredith, C.R. & *Trillium* Working Group 2019

NatureServe Global Rank Reviewer(s): Treher, A. & Frances, A.

Refs: 1, 11–13, 26, 32, 42, 48, 49, 54, 55, 57, 59, 64, 69, 71–74, 76, 81, 83–86, 104, 109, 113, 124, 131, 220–225

Trillium reliquum

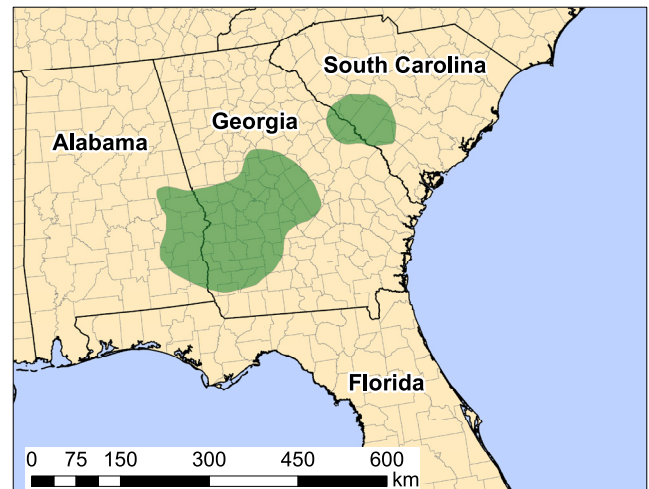
J.D. Freeman

Sessile

Near Threatened

Vulnerable (G3)

US: AL, GA, SC



Relict Trillium (*Trillium reliquum*) has a disjunct distribution, with eastern subpopulations in Aiken and Edgefield Counties, South Carolina and adjacent portions of Georgia in Columbia and Burke County. Western subpopulations occur just east of Macon, Georgia to Bullock County, Alabama and from Henry County, Georgia in the north, to Miller County, Georgia in the south. The species occurs in mixed deciduous forests on slopes, bluffs, and the floodplains of riparian areas. Threats to the species include herbivory by overabundant White-tailed Deer, disturbance by feral Pigs, improper timing of prescribed fires, and invasive species including Japanese Stiltgrass, Chinese Privet, and Trifoliate Orange. The species is known to be in cultivation, but trade is thought to be minimal. Its population is thought to be in decline. The species was listed as Endangered in 1988 under the U.S. Endangered Species Act, but this protection does not extend to private land. Due to its relatively small range and large number of threats, this species is at moderate risk of extinction.

Red List Assessor(s): Meredith, C.R., Schilling, E.E. & *Trillium* Working Group 2019

NatureServe Global Rank Reviewer(s): Treher, A.

Refs: 1, 11, 12, 25, 32, 48, 49, 55, 57, 59, 69, 71–74, 76, 77, 83–86, 91, 101, 109, 131, 168, 196, 197, 223, 225–231

Trillium rugelii

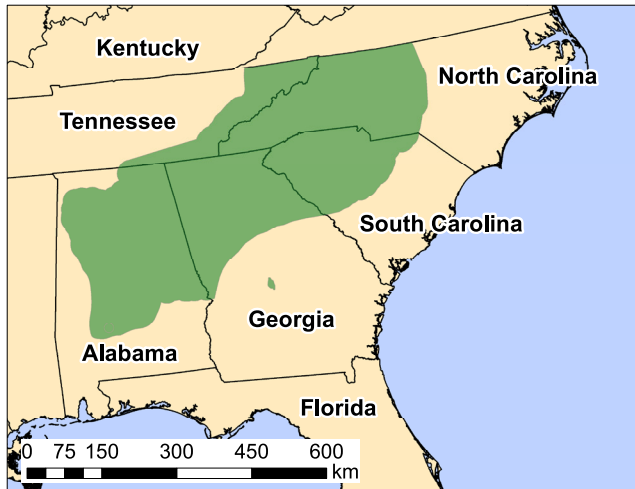
Rendle

Pedicellate

Least Concern

Apparently Secure (G4)

US: AL, GA, SC, NC, TN



Southern Nodding Trillium (*Trillium rugelii*) occurs in the southern Appalachian range and adjacent Piedmont areas from Alabama to North Carolina. The species is locally common in Georgia and is rare or uncommon elsewhere in its range. Its population is thought to be relatively stable. It is occasionally planted for ornamental purposes and may be included in herbal remedies marketed as bethroot. The species is threatened by habitat loss resulting from logging and silviculture operations, excessive herbivory caused by overabundance of White-tailed Deer, habitat quality declines associated with feral Pigs, and habitat loss due to residential and commercial development. Threats to the species are numerous and additional monitoring of population trends is warranted, but the species is considered to be at a low risk of extinction.

Red List Assessor(s): Meredith, C.R. & *Trillium* Working Group 2019

NatureServe Global Rank Reviewer(s): Treher, A. & Frances, A.

Refs: 1, 11–14, 25, 32, 48, 49, 55, 57, 59, 64, 69, 71–74, 76, 77, 81, 83–86, 104, 108–110, 117, 124, 228, 232, 233

Trillium sessile

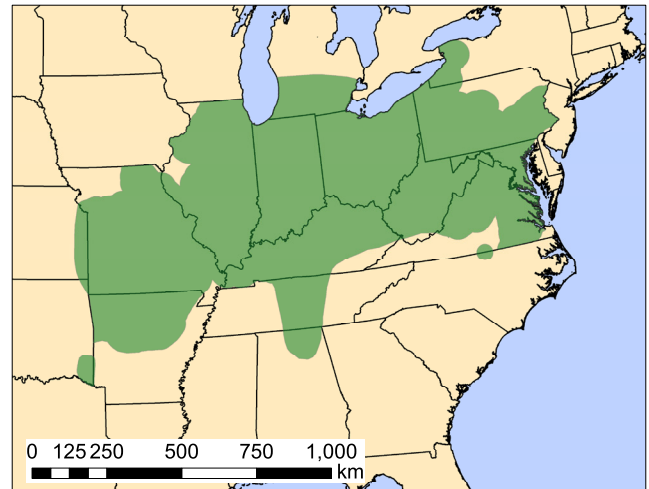
L.

Sessile

Least Concern

Apparently Secure (G4)

US: AL, AR, DC, IL, IN, KS, KY, MD, MI, MO, NY, NC, OH, OK, PA, TN, VA, WV



Sessile Trillium (*Trillium sessile*) occurs from western New York in Chautauqua County south to the coastal plain of North Carolina, west to extreme eastern portions of Oklahoma and Kansas, and north to southern Michigan. It occurs in rich woodlands under a variety of moisture regimes ranging from riverbanks and floodplains to dry upland woods. The species is abundant in portions of its range. Threats to the species include herbivory pressure caused by overabundance of White-tailed Deer, habitat degradation from feral Pigs, invasive plant species, and impacts from logging. Additional monitoring is needed to determine the population trajectory of the species, although it is currently thought to be stable. Due to a large population across vast areas of favorable habitat, this species is considered to be at low risk of extinction.

Red List Assessor(s): Meredith, C.R. & *Trillium* Working Group 2019

NatureServe Global Rank Reviewer(s): Treher, A.

Refs: 1, 11, 13, 14, 25, 29, 32, 42, 48, 49, 54, 55, 57, 59, 64, 69, 71–77, 81, 83–86, 101, 108, 109, 113, 120, 123, 160, 234

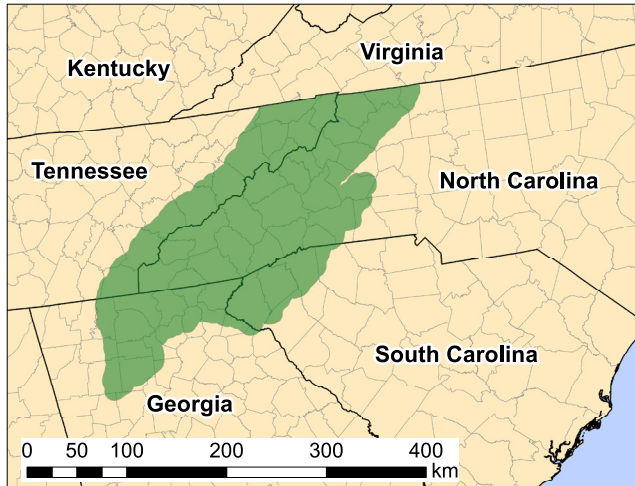
Trillium simile

Gleason

Pedicellate

Vulnerable B1ab(iii,v)+2ab(iii,v) Vulnerable (G3)

US: GA, NC, SC, TN



Jeweled Wakerobin (*Trillium simile*) occurs in a restricted range within the southern Appalachian Mountains. It is found in rich cove forests and forest edges along the border of Tennessee and North Carolina, and south to northwestern South Carolina and northern Georgia. The species is known from 50 extant occurrences and has a relatively large population. The primary threats to the species include habitat degradation caused by feral Pigs, herbivory associated with overabundant White-tailed Deer, and habitat loss due to residential development. The species is considered to be at moderate risk of extinction due to declining habitat quality, and its restricted range.

Red List Assessor(s): Meredith, C.R. & *Trillium* Working Group 2019

NatureServe Global Rank Reviewer(s): Treher, A.

Refs: 1, 11–13, 32, 48, 49, 55, 57, 69, 71–74, 76, 77, 81, 83, 84, 86, 131, 142, 164, 179, 229, 235

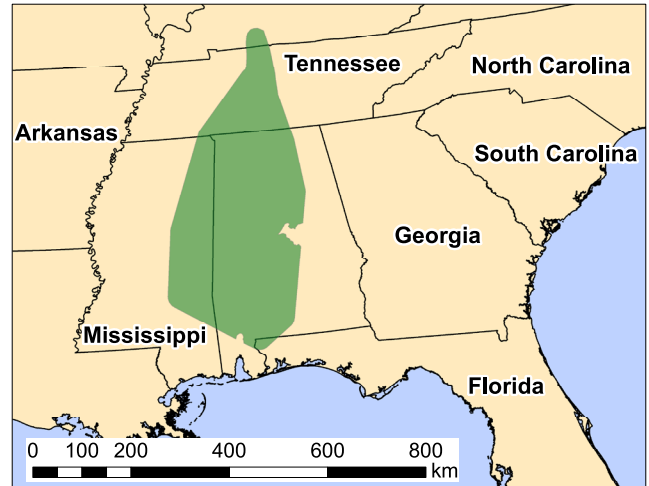
Trillium stamineum

Harb.

Sessile

Least Concern Apparently Secure (G4)

US: AL, KY, MS, TN



Twisted Trillium (*Trillium stamineum*) is a long-lived spring wildflower that occurs in the southern United States. The species can be found from central Tennessee southward through Alabama and the eastern portions of Mississippi. It prefers open deciduous or mixed-deciduous forests on a variety of substrates. The peculiar shape of the species' flowers makes it appealing to horticulturalists, though the current market is relatively small. The species is locally abundant in much of its range and is common in northern Alabama. Threats to the species are poorly understood, and additional research and population monitoring are needed. Due to its large population within a relatively expansive range, the species is at low risk of extinction.

Red List Assessor(s): Meredith, C.R. & *Trillium* Working Group 2019

NatureServe Global Rank Reviewer(s): Treher, A.

Refs: 1, 11, 13, 25, 32, 48, 49, 54, 55, 57, 69, 71–74, 76, 81, 83–86, 101, 109

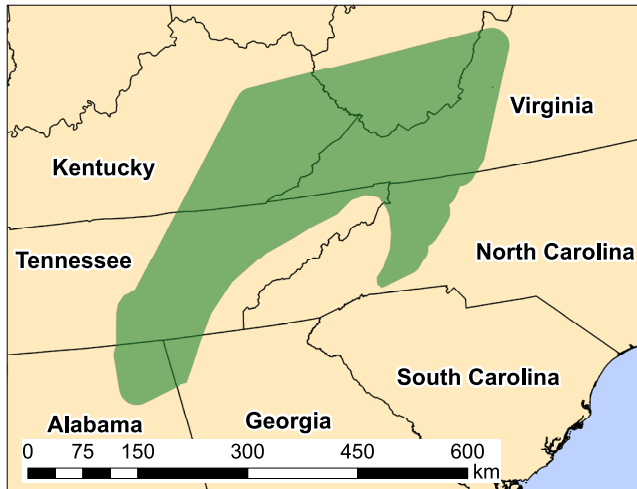
Trillium sulcatum

T.S.Patrick

Pedicellate

Least Concern Apparently Secure (G4)

US: AL, GA, KY, NC, TN, VA, WV



Barksdale Trillium (*Trillium sulcatum*) occurs predominantly on the Cumberland Plateau and in the central Blue Ridge Mountains and adjacent areas ranging from Alabama north to Kentucky. The species is locally common, though additional population data are needed to determine the population trend. It occurs in rich mesic forest habitats on a variety of substrates. Like other *Trillium* species, Barksdale Trillium is threatened by herbivory pressure from an overabundance of White-tailed Deer, habitat disturbance caused by feral Pigs, logging, and habitat loss to silviculture. Conservation efforts should focus initially on research to determine basic life-history, population trends, and the impact of threats to the species. Because the species is relatively common across a large area, it is considered to be at low risk of extinction.

Red List Assessor(s): Meredith, C.R. & *Trillium* Working Group 2019

NatureServe Global Rank Reviewer(s): Treher, A.

Refs: 1, 11–15, 32, 48, 49, 54, 55, 57, 59, 69, 71–74, 76, 77, 81, 83, 84, 86, 110, 124, 164, 236–239

Trillium tennesseense

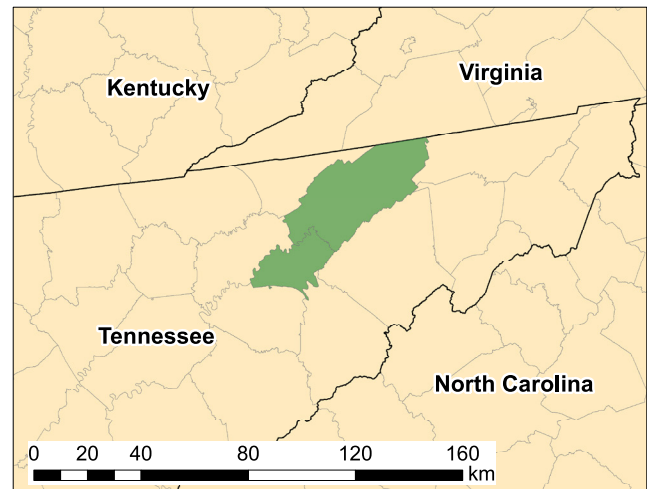
E.E.Schill. & Floden

Sessile

Critically Endangered B1ab(iii,iv,v)+2ab(iii,iv,v)*

Critically Imperiled (G1)

US: TN



Tennessee Trillium (*Trillium tennesseense*) is a narrow endemic of the Bays Mountain formation in Hamblen and Hawkins Counties, Tennessee. The taxon occurs in four small subpopulations on floodplains, along drainages, and on midslopes of Sevier shale formations. All known subpopulations are located on private land. The taxon is threatened by collection for horticultural purposes, competing invasive species, land conversion, and a fungal infection of unknown origin. The species is considered to be at an extremely high risk of extinction.

*The Red List considers *T. tennesseense* as a synonym of *T. lancifolium*. Considered separately, *T. tennesseense* would qualify for listing as Critically Endangered under criteria B1ab(iii,iv,v).

Red List Assessor(s): Meredith, C.R. & *Trillium* Working Group 2019

NatureServe Global Rank Reviewer(s): Treher, A. & Frances, A.

Refs: 1, 11–15, 32, 48, 49, 54, 55, 57, 59, 69, 71–74, 76, 77, 81, 83–86, 101, 104, 106, 108, 110, 113, 160–163

Trillium texanum

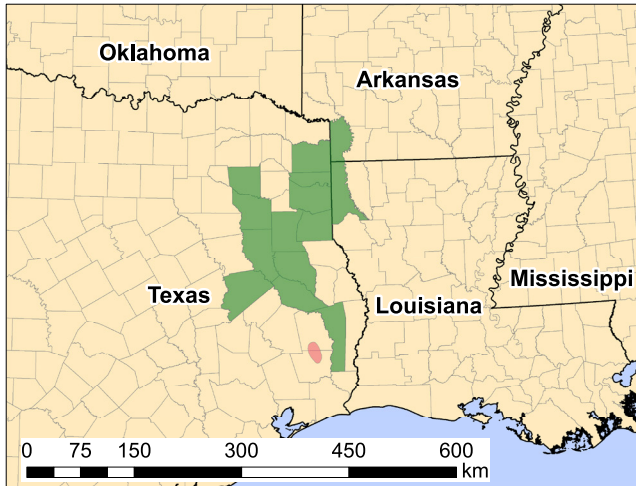
Buckley

Pedicellate

Vulnerable B2ab(iii)

US: AR, LA, TX

Imperiled (G2)



Texas Trillium (*Trillium texanum*) is found in wetland areas of eastern Texas, northwest Louisiana, and southern Arkansas. The species occurs in 24 subpopulations scattered across its range in creek bottom bogs in association with mixed deciduous forests. Several threats to the species are known, primarily related to logging and hydrological changes. Five sites are known to have some level of official protection and two more are managed by the State of Texas or included in conservation easements. Given the pervasive nature of the threats to the species' survival, namely wetland drainage and rooting caused by feral Pigs and that the species can be considered to occur in fewer than 10 locations the extinction risk is moderate to high risk.

Red List Assessor(s): Meredith, C.R. & *Trillium* Working Group 2019

NatureServe Global Rank Reviewer(s): Treher, A.

Refs: 1, 11–13, 15, 48, 49, 49, 55, 57, 57, 58, 69, 71–74, 76, 83, 84, 86, 124, 138, 153, 240, 241

Trillium underwoodii

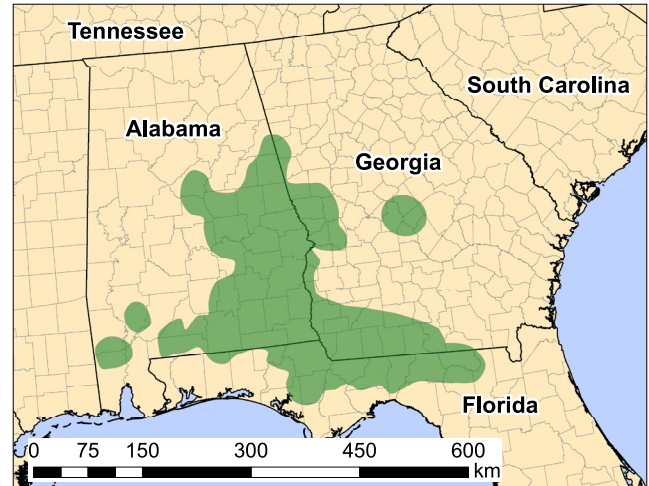
Small

Sessile

Least Concern

US: AL, FL, GA

Apparently Secure (G4)



Underwood's Trillium (*Trillium underwoodii*) occurs in southern Alabama, southwestern Georgia, and northern Florida. Little is known about the species' population, but several subpopulations are noted to be large. The species may be threatened by a variety of factors including herbivory from over abundant White-tailed Deer, habitat degradation caused by feral Pigs, and habitat loss due to urbanization and logging. Several invasive plants may also negatively impact the species including Japanese Stiltgrass, Bush Honeysuckle, English Ivy, Chinese Privet, and Trifoliolate Orange. The magnitude of these threats is poorly understood, and additional research is needed. The species occurs across a relatively broad area, and no specific threats are known to have caused population declines. As such, the species is considered to have a low risk of extinction.

Red List Assessor(s): Meredith, C.R. & *Trillium* Working Group 2019

NatureServe Global Rank Reviewer(s): Treher, A.

Refs: 1, 11, 13, 14, 25, 48, 49, 54, 55, 57, 69, 71–74, 76, 77, 83–86, 101, 230

Trillium vaseyi

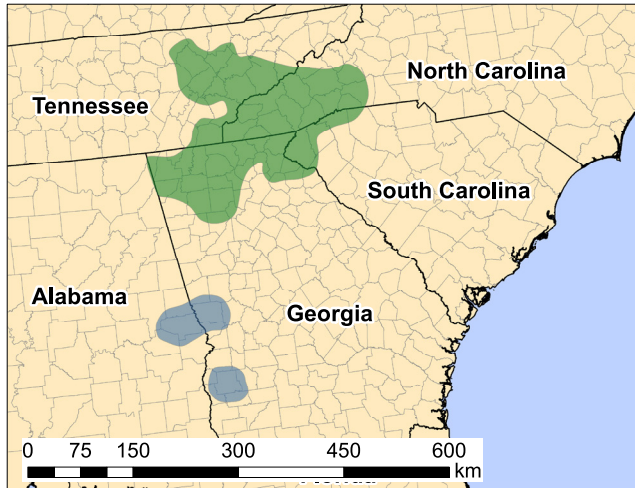
Harb.

Pedicellate

Near Threatened B1ab(iii)

Vulnerable (G3)

US: AL^U, GA, NC, SC, TN



Vasey's Trillium (*Trillium vaseyi*) is a narrowly distributed endemic of the southern Blue Ridge Mountains. Subpopulations to the south extending into west-central Georgia and portions of Alabama are of dubious taxonomic status and it is doubtful that the species occurs in this area. Although little is known about the population, it is threatened within its range by high herbivory pressure from overabundant White-tailed Deer, and habitat degradation caused by rooting feral Pigs. Collection pressure for horticultural markets may also impact some subpopulations. Though much of the species' range occurs within protected areas, these protections do not adequately address the threat posed by logging and invasive Hemlock Woolly Adelgid. Many protected areas within the species' range are periodically logged, potentially leading to habitat degradation. Because the species has a limited distribution and undergoing ongoing habitat quality declines, it is thought to be at a moderate risk of extinction.

Red List Assessor(s): Meredith, C.R. & *Trillium* Working Group 2019

NatureServe Global Rank Reviewer(s): Treher, A. & Frances, A.

Refs: 1, 11, 13–15, 25, 48, 49, 54, 55, 57, 69, 71–74, 76, 78, 81, 83–86, 108–110, 138, 229, 232, 242, 243

Trillium viride

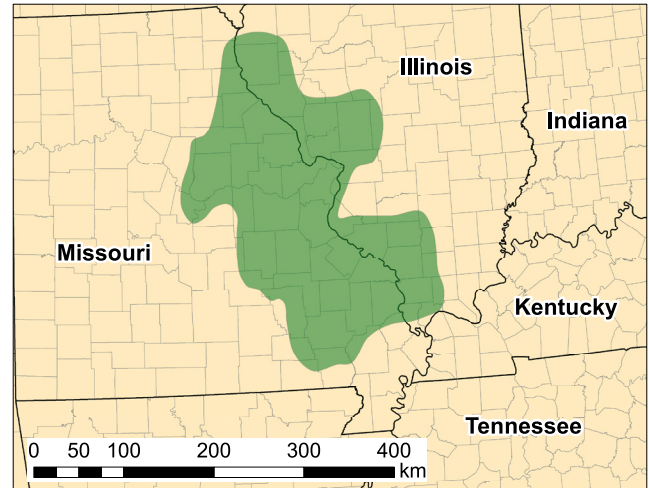
Beck

Sessile

Least Concern

Vulnerable (G3G4)

US: IL, KY^U, MO, TN^U



Green Trillium (*Trillium viride*) occurs in northeastern Missouri and southwestern Illinois on rich clay soils in counties adjacent to the Missouri River. The species is found on bluffs and rocky hillsides in woodland areas characterized by limestone substrates and rich clay soils. Little is known about the population size of this species primarily because of confusion with related species, and resulting disagreement over the species' range. Several threats that impact *Trillium* species in eastern North America are likely to affect this species. This includes overabundance of White-tailed Deer, habitat destruction and degradation caused by logging, habitat degradation associated with feral Pigs, and competition with invasive plants. The impact of these threats on Green Trillium subpopulations is poorly understood, and additional research is needed to determine the population trend of the species. Because the species has a large population and no severe threats, it is thought to have a low to moderate risk of extinction.

Red List Assessor(s): Meredith, C.R. & *Trillium* Working Group 2019

NatureServe Global Rank Reviewer(s): Treher, A. & Frances, A.

Refs: 1, 11–13, 15, 24, 25, 28–30, 48, 49, 55, 57, 69, 71–74, 76, 78, 81, 83–86, 108, 109, 123, 138, 164, 229, 244, 245

Trillium viridescens

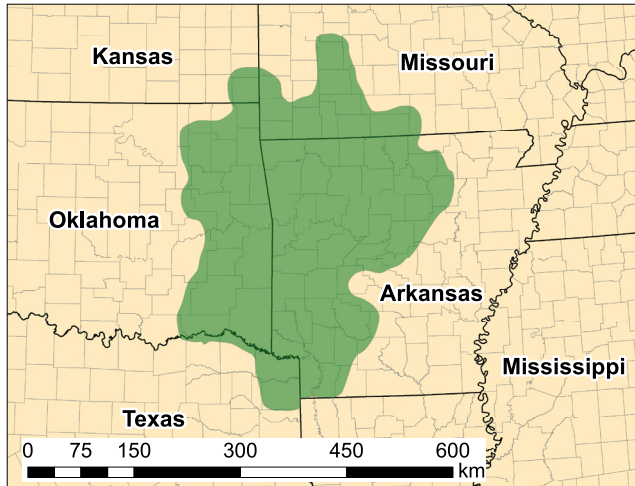
Nutt.

Sessile

Least Concern

Apparently Secure (G4)

US: AR, KS, LA, MO, OK, TX



Ozark Green Trillium (*Trillium viridescens*) occurs from southern Missouri and southeast Kansas to extreme eastern portions of Texas. The species is locally common throughout its range on rich clay soils on rocky bluffs, talus slopes, and floodplains. The population trend of the species is not currently known. Threats that may impact the species include herbivory pressure from overabundant White-tailed Deer, logging, habitat degradation caused by feral Pigs, and invasive plants including Burning Bush and Bush Honeysuckle. Because the species is locally common across a broad distribution, it is at a low risk of extinction.

Red List Assessor(s): Meredith, C.R. & *Trillium* Working Group 2019

NatureServe Global Rank Reviewer(s): Frances, A.

Refs: 1, 11, 12, 15, 24, 25, 28–30, 48, 49, 54, 55, 57, 69, 71–74, 76, 78, 81, 83, 84, 86, 101, 108, 123, 138, 164, 216, 229, 246, 247

Photos



Figure 8: *Pseudotrillium rivale* (K. Wayman)



Figure 10: *Trillium albidum* subsp. *albidum* (K. Wayman)



Figure 11: *Trillium albidum* subsp. *parviflorum* (K. Wayman)



Figure 9: *Trillidium undulatum* (E.E. Schilling)



Figure 12: *Trillium angustipetalum* (K. Wayman)



Figure 13: *Trillium catesbaei* (L.L. Gaddy)



Figure 16: *Trillium cuneatum* (E.E. Schilling)



Figure 14: *Trillium cernuum* (K. Filicky)



Figure 17: *Trillium decipiens* (E.E. Schilling)



Figure 15: *Trillium chloropetalum* (K. Wayman)



Figure 18: *Trillium decumbens* (E.E. Schilling)



Figure 19: *Trillium delicatum* (E.E. Schilling)



Figure 20: *Trillium discolor* (E.E. Schilling)



Figure 21: *Trillium erectum* (T. Littlefield)



Figure 22: *Trillium flexipes* (T. Littlefield)



Figure 23: *Trillium foetidissimum* (Mt. Cuba Center)



Figure 26: *Trillium grandiflorum* (T. Littlefield)



Figure 24: *Trillium georgianum* (E.E. Schilling)



Figure 27: *Trillium kurabayashii* (K. Wayman)



Figure 25: *Trillium gracile* (J. Singhurst)



Figure 28: *Trillium lancifolium* (E.E. Schilling)



Figure 29: *Trillium ludovicianum* (H. and C. Nourse)



Figure 30: *Trillium luteum* (E.E. Schilling)



Figure 31: *Trillium maculatum* (Mt. Cuba Center)



Figure 32: *Trillium nivale* (Mt. Cuba Center)



Figure 33: *Trillium oostingii* (L.L. Gaddy)



Figure 36: *Trillium ovatum* subsp. *ovatum* (K. Wayman)



Figure 34: *Trillium hibbersonii* (E.E. Schilling)



Figure 37: *Trillium persistens* (L.L. Gaddy)



Figure 35: *Trillium ovatum* subsp. *oettingeri* (K. Wayman)



Figure 38: *Trillium petiolatum* (K. Wayman)



Figure 39: *Trillium pusillum* var. 1 (A. Schotz)



Figure 40: *Trillium pusillum* var. *monticulum* (West Virginia Natural Heritage Program)



Figure 41: *Trillium pusillum* var. *ozarkanum* (T. Littlefield)



Figure 42: *Trillium pusillum* var. 5 (W. Knapp)



Figure 43: *Trillium pusillum* var. *virginianum* (R. Raguso)



Figure 44: *Trillium recurvatum* (L.L. Gaddy)



Figure 45: *Trillium reliquum* (L.L. Gaddy)



Figure 46: *Trillium rugelii* (L.L. Gaddy)



Figure 47: *Trillium sessile* (T. Littlefield)



Figure 48: *Trillium simile* (Mt. Cuba Center)



Figure 49: *Trillium stamineum* (E.E. Schilling)



Figure 50: *Trillium sulcatum* (E.E. Schilling)



Figure 52: *Trillium texanum* (Anna Strong)



Figure 51: *Trillium tennesseense* (E.E. Schilling)



Figure 53: *Trillium underwoodii* (H. and C. Nourse)



Figure 54: *Trillium vaseyi* (L.L. Gaddy)



Figure 55: *Trillium viride* (A. Floden)



Figure 56: *Trillium viridescens* (H. and C. Nourse)

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Appendix A: All Red List Category and Criteria Designations

Taxon Name	Red List Taxon Rank	Red List Category	Red List Criteria	Red List Complex Designation
<i>Pseudotrillium rivale</i>	Species	VU	B1ab(iv)	
<i>Trillium albidum</i>	Species	LC		
<i>Trillium angustipetalum</i>	Species	DD		
<i>Trillium catesbaei</i>	Species	LC		
<i>Trillium cernuum</i>	Species	LC		
<i>Trillium chloropetalum</i>	Species	DD		
<i>Trillium cuneatum</i>	Species	LC		
<i>Trillium decipiens</i>	Species	LC		
<i>Trillium decumbens</i>	Species	LC		
<i>Trillium delicatum</i>	Species	EN	B1ab(iii,v)	
<i>Trillium discolor</i>	Species	NT		
<i>Trillium erectum</i>	Species	LC		
<i>Trillium flexipes</i>	Species	LC		
<i>Trillium foetidissimum</i>	Species	LC		
<i>Trillium georgianum</i>	Species	CR	B1ab(iii,v)+2ab(iii,v)	
<i>Trillium gracile</i>	Species	NT	B2b(iii)	
<i>Trillium grandiflorum</i>	Species	LC		
<i>Trillium kurabayashii</i>	Species	VU	D1	
<i>Trillium lancifolium</i>	Species	EN	B2ab(iii,v)	
<i>Trillium ludovicianum</i>	Species	LC		
<i>Trillium luteum</i>	Species	LC		
<i>Trillium maculatum</i>	Species	DD		
<i>Trillium nivale</i>	Species	LC		
<i>Trillium oostingii</i>	Species	EN	B1ab(v)+2ab(v)	
<i>Trillium ovatum</i>	Species	LC		<i>Trillium ovatum</i>
<i>Trillium crassifolium</i>	Variety	DD		<i>Trillium ovatum</i>
<i>Trillium hibbersonii</i>	Variety	VU	D1	<i>Trillium ovatum</i>
<i>Trillium ovatum</i> subsp. <i>oettingeri</i>	Subspecies	DD		<i>Trillium ovatum</i>
<i>Trillium scouleri</i>	Subspecies	LC		<i>Trillium ovatum</i>
<i>Trillium parviflorum</i>	Species	VU	C2a(i)	
<i>Trillium persistens</i>	Species	VU	D2	

Appendix A: All Red List Category and Criteria Designations

Taxon Name	Red List Taxon Rank	Red List Category	Red List Criteria	Red List Complex Designation
<i>Trillium petiolatum</i>	Species	LC		
<i>Trillium pusillum</i> var. <i>monticulum</i>	Variety	EN	B1ab(iii)+2ab(iii)	<i>Trillium pusillum</i>
<i>Trillium pusillum</i> var. <i>ozarkanum</i>	Variety	LC		<i>Trillium pusillum</i>
<i>Trillium pusillum</i> var. <i>pusillum</i>	Variety	LC		<i>Trillium pusillum</i>
<i>Trillium pusillum</i> var. <i>virginianum</i>	Variety	VU	B1ab(iii)	<i>Trillium pusillum</i>
<i>Trillium pusillum</i> var. <i>1</i>	Variety	LC		<i>Trillium pusillum</i>
<i>Trillium pusillum</i> var. <i>3</i>	Variety	CR	B2ab(iii);D	<i>Trillium pusillum</i>
<i>Trillium pusillum</i> var. <i>4</i>	Variety	VU	B1ab(i,iii,iv,v)	<i>Trillium pusillum</i>
<i>Trillium pusillum</i> var. <i>5</i>	Variety	VU	B1ab(iii)	<i>Trillium pusillum</i>
<i>Trillium recurvatum</i>	Species	LC		
<i>Trillium reliquum</i>	Species	NT		
<i>Trillium rugelii</i>	Species	LC		
<i>Trillium sessile</i>	Species	LC		
<i>Trillium simile</i>	Species	VU	B1ab(iii,v)+2ab(iii,v)	
<i>Trillium stamineum</i>	Species	LC		
<i>Trillium sulcatum</i>	Species	LC		
<i>Trillium tennesseeense</i>	Variety	CR	B1ab(iii,iv,v)+2ab(iii,iv,v)	<i>Trillium lancifolium</i>
<i>Trillium texanum</i>	Species	VU	B2ab(iii)	
<i>Trillium underwoodii</i>	Species	LC		
<i>Trillium undulatum</i>	Species	LC		
<i>Trillium vaseyi</i>	Species	NT	B1ab(iii)	
<i>Trillium viride</i>	Species	LC		
<i>Trillium viridescens</i>	Species	LC		

Appendix B: All NatureServe Rankings

Taxon Name	NatureServe Taxon Rank	NatureServe Rank	NatureServe Complex Designation
<i>Pseudotrillium rivale</i>	Species	G3	
<i>Trillidium undulatum</i>	Species	G5	
<i>Trillium albidum</i>	Species	G4	<i>Trillium albidum</i>
<i>Trillium albidum</i> subsp. <i>albidum</i>	Subspecies	T4	<i>Trillium albidum</i>
<i>Trillium albidum</i> subsp. <i>parviflorum</i>	Subspecies	T2	<i>Trillium albidum</i>
<i>Trillium angustipetalum</i>	Species	G4	
<i>Trillium catesbaei</i>	Species	G4	
<i>Trillium cernuum</i>	Species	G5	
<i>Trillium chloropetalum</i>	Species	G4	
<i>Trillium crassifolium</i>	Species	G1	
<i>Trillium cuneatum</i>	Species	G4	
<i>Trillium decipiens</i>	Species	G3	
<i>Trillium decumbens</i>	Species	G4	
<i>Trillium delicatum</i>	Species	G1	
<i>Trillium discolor</i>	Species	G3	
<i>Trillium erectum</i>	Species	G5	
<i>Trillium flexipes</i>	Species	G5	
<i>Trillium foetidissimum</i>	Species	G3	
<i>Trillium georgianum</i>	Species	G1	
<i>Trillium gracile</i>	Species	G2	
<i>Trillium grandiflorum</i>	Species	G5	
<i>Trillium hibbersonii</i>	Species	G3	
<i>Trillium kurabayashii</i>	Species	G3	
<i>Trillium lancifolium</i>	Species	G3	
<i>Trillium ludovicianum</i>	Species	G4	
<i>Trillium luteum</i>	Species	G4	
<i>Trillium maculatum</i>	Species	G4	
<i>Trillium nivale</i>	Species	G4	
<i>Trillium oostingii</i>	Species	G1	
<i>Trillium ovatum</i>	Species	G5	
<i>Trillium ovatum</i> var. <i>oettingeri</i>	Variety	T4	
<i>Trillium ovatum</i> var. <i>ovatum</i>	Variety	T5	
<i>Trillium persistens</i>	Species	G1	

Appendix B: All NatureServe Rankings

Taxon Name	NatureServe Taxon Rank	NatureServe Rank	NatureServe Complex Designation
<i>Trillium petiolatum</i>	Species	G4	
<i>Trillium pusillum</i>	Species	G4	<i>Trillium pusillum</i>
<i>Trillium pusillum</i> var. <i>monticulum</i>	Variety	T2	<i>Trillium pusillum</i>
<i>Trillium pusillum</i> var. <i>ozarkanum</i>	Variety	T3	<i>Trillium pusillum</i>
<i>Trillium pusillum</i> var. <i>pusillum</i>	Variety	T3	<i>Trillium pusillum</i>
<i>Trillium pusillum</i> var. <i>virginianum</i>	Variety	T3	<i>Trillium pusillum</i>
<i>Trillium pusillum</i> var. <i>1</i>	Not Accepted	GNR	<i>Trillium pusillum</i>
<i>Trillium pusillum</i> var. <i>3</i>	Not Accepted	GNR	<i>Trillium pusillum</i>
<i>Trillium pusillum</i> var. <i>4</i>	Not Accepted	GNR	<i>Trillium pusillum</i>
<i>Trillium pusillum</i> var. <i>5</i>	Not Accepted	GNR	<i>Trillium pusillum</i>
<i>Trillium recurvatum</i>	Species	G5	
<i>Trillium reliquum</i>	Species	G3	
<i>Trillium rugelii</i>	Species	G4	
<i>Trillium scouleri</i>	Species	G4	
<i>Trillium sessile</i>	Species	G5	
<i>Trillium simile</i>	Species	G3	
<i>Trillium stamineum</i>	Species	G4	
<i>Trillium sulcatum</i>	Species	G4	
<i>Trillium tennesseense</i>	Species	G1	
<i>Trillium texanum</i>	Species	G3	
<i>Trillium underwoodii</i>	Species	G4	
<i>Trillium vaseyi</i>	Species	G3	
<i>Trillium viride</i>	Species	G3	
<i>Trillium viridescens</i>	Species	G4	

Appendix C: Red List Categories and Criteria

SUMMARY OF THE FIVE CRITERIA (A-E) USED TO EVALUATE IF A TAXON BELONGS IN AN IUCN RED LIST THREATENED CATEGORY (CRITICALLY ENDANGERED, ENDANGERED OR VULNERABLE).¹

A. Population size reduction. Population reduction (measured over the longer of 10 years or 3 generations) based on any of A1 to A4			
	Critically Endangered	Endangered	Vulnerable
A1	≥ 90%	≥ 70%	≥ 50%
A2, A3 & A4	≥ 80%	≥ 50%	≥ 30%
<p>A1 Population reduction observed, estimated, inferred, or suspected in the past where the causes of the reduction are clearly reversible AND understood AND have ceased.</p> <p>A2 Population reduction observed, estimated, inferred, or suspected in the past where the causes of reduction may not have ceased OR may not be understood OR may not be reversible.</p> <p>A3 Population reduction projected, inferred or suspected to be met in the future (up to a maximum of 100 years) [(a) cannot be used for A3].</p> <p>A4 An observed, estimated, inferred, projected or suspected population reduction where the time period must include both the past and the future (up to a max. of 100 years in future), and where the causes of reduction may not have ceased OR may not be understood OR may not be reversible.</p>	<p>based on any of the following:</p>		<p>(a) direct observation [except A3]</p> <p>(b) an index of abundance appropriate to the taxon</p> <p>(c) a decline in area of occupancy (AOO), extent of occurrence (EOO) and/or habitat quality</p> <p>(d) actual or potential levels of exploitation</p> <p>(e) effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites.</p>
B. Geographic range in the form of either B1 (extent of occurrence) AND/OR B2 (area of occupancy)			
	Critically Endangered	Endangered	Vulnerable
B1. Extent of occurrence (EOO)	< 100 km ²	< 5,000 km ²	< 20,000 km ²
B2. Area of occupancy (AOO)	< 10 km ²	< 500 km ²	< 2,000 km ²
AND at least 2 of the following 3 conditions:			
(a) Severely fragmented OR Number of locations	= 1	≤ 5	≤ 10
(b) Continuing decline observed, estimated, inferred or projected in any of: (i) extent of occurrence; (ii) area of occupancy; (iii) area, extent and/or quality of habitat; (iv) number of locations or subpopulations; (v) number of mature individuals			
(c) Extreme fluctuations in any of: (i) extent of occurrence; (ii) area of occupancy; (iii) number of locations or subpopulations; (iv) number of mature individuals			
C. Small population size and decline			
	Critically Endangered	Endangered	Vulnerable
Number of mature individuals	< 250	< 2,500	< 10,000
AND at least one of C1 or C2			
C1. An observed, estimated or projected continuing decline of at least (up to a max. of 100 years in future):	25% in 3 years or 1 generation (whichever is longer)	20% in 5 years or 2 generations (whichever is longer)	10% in 10 years or 3 generations (whichever is longer)
C2. An observed, estimated, projected or inferred continuing decline AND at least 1 of the following 3 conditions:			
(a) (i) Number of mature individuals in each subpopulation	≤ 50	≤ 250	≤ 1,000
(ii) % of mature individuals in one subpopulation =	90–100%	95–100%	100%
(b) Extreme fluctuations in the number of mature individuals			
D. Very small or restricted population			
	Critically Endangered	Endangered	Vulnerable
D. Number of mature individuals	< 50	< 250	D1. < 1,000
D2. Only applies to the VU category Restricted area of occupancy or number of locations with a plausible future threat that could drive the taxon to CR or EX in a very short time.	-	-	D2. typically: AOO < 20 km ² or number of locations ≤ 5
E. Quantitative Analysis			
	Critically Endangered	Endangered	Vulnerable
Indicating the probability of extinction in the wild to be:	≥ 50% in 10 years or 3 generations, whichever is longer (100 years max.)	≥ 20% in 20 years or 5 generations, whichever is longer (100 years max.)	≥ 10% in 100 years

¹ Use of this summary sheet requires full understanding of the IUCN Red List Categories and Criteria and Guidelines for Using the IUCN Red List Categories and Criteria. Please refer to both documents for explanations of terms and concepts used here.

Appendix D: Table of Common Names Used in Text

Common Name	Latin Name	Author
American Ginseng	<i>Panax quinquefolius</i>	L.
Azaleas	<i>Rhododendron spp.</i>	L.
Bigleaf Maple	<i>Acer macrophyllum</i>	Pursh.
Black Gum	<i>Nyssa sylvatica</i>	Marshall
Blowflies	<i>Calliphoridae</i>	Brauer & Bergenstamm, 1889
Burning Bush	<i>Euonymus alatus</i>	(Thunb.) Rupr.
Bush Honeysuckle	<i>Lonicera maackii</i>	(Rupr.) Maxim
Chinese Privet	<i>Ligustrum sinense</i>	Lour.
Cougar	<i>Puma concolor</i>	Linnaeus, 1771
Douglas-fir	<i>Pseudotsuga menziesii</i>	(Mirb.) Franco
Elk	<i>Cervus canadensis</i>	(Erxleben, 1777)
English Ivy	<i>Hedera helix</i>	L.
Garlic Mustard	<i>Alliaria petiolata</i>	(M. Bieb.) Cavara & Grande
Gray Wolf	<i>Canis lupus</i>	Linnaeus, 1758
Green Ash	<i>Fraxinus pennsylvanica</i>	Marshall
Hemlock Woolly Adelgid	<i>Adelges tsugae</i>	(Annand, 1928)
Himalayan Blackberry	<i>Rubus armeniacus</i>	Focke
Japanese Honeysuckle	<i>Lonicera japonica</i>	(Lour.) Merr.
Japanese Stiltgrass	<i>Microstegium vimineum</i>	(Trin.) A.Camus
Kinugasasō	<i>Paris japonica</i>	Franch.
Kudzu	<i>Pueraria montana</i>	Thunb.
Mother Wort	<i>Leonurus cardiaca</i>	L.
Oak	<i>Quercus spp.</i>	L.
Pig	<i>Sus scrofa</i>	Linnaeus, 1758
Raspberry	<i>Rubus iadeus</i>	L.
Red Alder	<i>Alnus rubra</i>	Bong.
Red Maple	<i>Acer rubrum</i>	L.
Shepherd's Purse	<i>Capsella bura-pastoris</i>	Moench.
Silverberry	<i>Elaeagnus commutata</i>	Bernh. ex Rydb.
Sitka Spruce	<i>Picea sitchensis</i>	Bong.
Trifoliolate Orange	<i>Poncirus trifoliata</i>	(L.) Raf.

Appendix D: Table of Common Names Used in Text

Common Name	Latin Name	Author
Western Hemlock	<i>Tsuga heterophylla</i>	Sarg.
Western Red Cedar	<i>Thuja plicata</i>	Donn ex D.Don
White-tailed Deer	<i>Odocoileus virginianus</i>	(Zimmerman, 1780)
Winter Creeper	<i>Euonymus fortunei</i>	(Turcz.) Hand.-Mazz.
Yarrow	<i>Achillea millefolium</i>	L.

The Conservation Status of *Trillium* in North America



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