

**Relict Trillium**  
**(*Trillium reliquum*)**

**5-Year Status Review:**  
**Summary and Evaluation**



Relict trillium. Photo by Brant Slay, The Nature Conservancy.

**U.S. Fish and Wildlife Service**  
**Southeast Region**  
**Georgia Ecological Services Field Office**  
**Athens, Georgia**

**September 2023**

**STATUS REVIEW**  
**Relict Trillium (*Trillium reliquum*)**

**GENERAL INFORMATION**

**Current Classification:** Endangered

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**Reviewers:**

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**Date of original listing:** May 4, 1988 (53 FR 10879, April 4, 1988)

**Methodology used to complete the review:** In accordance with section 4(c)(2) of the Endangered Species Act of 1973, as amended (Act), status reviews are to assess each threatened species or endangered species to determine whether its status has changed and if it should be classified differently or removed from the Lists of Threatened and Endangered Wildlife and Plants ([50 CFR 424.11](#)). The U.S. Fish and Wildlife Service (Service) evaluated the biology, habitat, and threats of the Relict trillium to inform this status review.

In conducting this 5-year review, the Service relied on the best available information pertaining to historical and current distributions, life history, ecology, and habitat of this species. Much of the information contained herein is taken from a Species Status Assessment Report (SSA, Service 2023) that was developed to inform a recommendation team considering the species' status, this 5-year review, and other documents associated with the Act. In addition to the Service, the core team responsible for the SSA included species experts from: the Alabama Natural Heritage Program, and Auburn University; Atlanta Botanical Garden; Augusta University; Georgia Natural Heritage Inventory Program and Georgia Department of Natural Resources; South Carolina Natural Heritage Program and South Carolina Department of Natural Resources; and Troy University. The SSA represents our evaluation of the best available scientific information, including the resource needs and the current and future condition of the species. Independent peer reviewers and partner representatives reviewed the SSA. Other sources for this status review include the final listing rule, published and unpublished reports and field observations, and personal communications from recognized experts in the field. We published an announcement in the Federal Register requesting information on this species

on March 25, 2020 (85 FR 16951), and a 60-day comment period was opened. We received no public comments during the open comment period. To complete this 5-year status review we used the information gathered by the Service since the 2015 relict trillium 5-year status review.

The SSA (Service 2022) is a peer-reviewed document that represents our evaluation of the best available scientific information regarding the biology, life history, and condition of the species. Because we have not received significant new information since the SSA was written, the level of public interest is low and non-controversial, no peer review on this 5-year review was conducted.

**FR Notice citation announcing the species is under active review:**

March 25, 2020 (85 FR 16951).

**Species' Recovery Priority Number at start of 5-year review ([48 FR 43098](#)):** 8c. The 2015 5-year review assigned a recovery priority number of 8, which indicates the species faces a moderate degree of threat and has a high recovery potential. The additional "c" ranking also assigned indicating conflict with construction and development projects or other forms of economic activity.

**Review History:** A previous 5-year review recommending no change in status was signed on January 20, 2015 (Service 2015).

## REVIEW ANALYSIS

### Listed Entity

#### **Taxonomy and nomenclature**

The relict trillium is recognized as a valid taxon in the Integrated Taxonomic Information System (ITIS) database ([ITIS 2022](#)). We are not aware of any changes to the taxonomy of this entity, and it is still considered valid by the Service.

#### **Distinct Population Segment (DPS) ([61 FR 4722](#))**

The Act defines species as including any subspecies of fish or wildlife or plants, and any distinct population segment of any species of vertebrate wildlife. Because this species is a plant, the Service's 1996 DPS Policy does not apply.

### Recovery Criteria

#### **Recovery Plan**

Relict Trillium Recovery Plan, January 31, 1991 (Service 1991)

Recovery plans are not regulatory documents and are intended to provide guidance to the Service, States, and other partners on methods of minimizing threats to listed species and on criteria that may be used to determine when recovery is achieved. If the recovery criteria defined in the plan are still valid, meeting recovery criteria can indicate that the species no longer

requires protections under the Act. However, when recommending whether a listed species should be delisted, the Service must apply the factors in section 4(a) of the Act ([84 FR 45020](#)).

The recovery plan (Service 1991) states that the relict trillium shall be considered for removal from the Federal list when the following criteria are met:

1. It has been documented that at least 12 populations (2 in Alabama, 7 in Georgia, and 3 in South Carolina) are self-sustaining and occur on sufficiently large tracts to ensure their perpetuation with a minimal amount of active management.
2. All of the above populations and their habitat are protected from present and foreseeable human-related and natural threats that may interfere with the survival of any of the populations.

### Recovery Criterion #1 Assessment

The recovery plan defines a self-sustaining population as a “reproducing population that is large enough to maintain sufficient genetic variation to enable it to survive and respond to natural habitat changes.” It further states that “The number of individuals necessary and the quantity and quality of habitat needed to meet these criteria will be determined as one of the recovery tasks.”

The task of determining the minimum population size (and related areal extent) constituting a self-sustaining population as well as the minimum amount and quality of habitat to support a self-sustaining population has not been undertaken. This critical lack of information must be considered in any discussion of protected populations. Populations, as described in this review, are occurrences of multiple relict trillium plants that may or may not prove to be self-sustaining populations based on as-yet undefined criteria. Lack of adequate gene-flow and pollen/propagule dispersal information makes any assessment of population difficult.

A threshold of five hundred reproductive individuals was presented as a possible approach for evaluating/estimating Element Occurrence (EO) sustainability in the 2015 Five-Year Status Review (Service 2015). Element occurrence boundaries circumscribed by state Natural Heritage Programs and EO data do not necessarily reflect populations as defined by gene flow. Analysis at a population level is preferable as it ideally captures gene flow and frequently comprises multiple occurrences and greater numbers of individuals. The approach in the recent relict trillium SSA (Service 2023) defined populations according to recent NatureServe (2020) EO delimitation guidelines that devised mapping standards to balance the need for fine-scale, highly site-specific EOs (required for monitoring and management) with the need to aggregate these records in meaningful units of conservation interest that may approximate biological populations. This necessitated coalescing some EOs into single populations using these guidelines, thus there is not a one-to-one correlation between EOs and populations in the SSA (Service 2023).

Furthermore, there is substantial variability in the timing of field surveys across the years by different surveyors and different state Natural Heritage Programs, as well as normal year-to-year variance in reproductive effort due to weather and other site-specific factors. Consequently, a reliance upon single season or random occasional observations of reproductive effort to inform a conservation and recovery analysis is not ideal. A more useful and reliable approach than the

“five hundred reproductive individual threshold” is to combine Demographic-Reproduction measures with Demographic-Abundance measures. Using this approach, 15 of 44 populations evaluated in the SSA had a resiliency rating of High or Moderate for both demographic factors (Table 1).

An estimation of the total number of relict trillium stems for the 44 populations analyzed in the recent SSA was 144,000<sup>1</sup> (Service 2023). Due to uncertainties and variability of stem count data (both censuses and estimates) resulting from differences in survey methodologies, taxonomic confusion involving the trillium “silverback complex”, lack of landowner permission preventing confirmation of suspected large relict trillium patches, and late arriving data (i.e., after completion of the SSA), the actual number of relict trillium stems across the range may exceed 300,000.

This criterion has been partially met overall. The criterion has been met in Georgia with 10 populations rated as either Moderate or High for both resiliency demographic factors: 1) abundance; and 2) reproduction. The criterion has also been met in Alabama with five populations rated as either Moderate or High for both demographic factors. The criterion has not been met in South Carolina with no populations rated as either Moderate or High for both demographic factors (Table 1).

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<sup>1</sup> There are five primary areas that contribute to stem count uncertainty; 1) Lee County, AL populations along Little Uchee Creek – rich areas lacking landowner permission to survey (Population #'s 1 and 2); 2) Muscogee County, GA population at Standing Boy State Park – taxonomic uncertainty involving Trillium “silverback complex” (Population # 25); 3) Jasper County, GA population along Ocmulgee River on Oconee NF –late data presented by NF needs to be reconciled with Georgia Natural Heritage Program data and may require thorough survey of Horse Camp Flats and Beech Ravine EOs (Population # 45); 4) Edgefield County, SC population along Savannah River – historical correspondence in SC Natural Heritage Program files suggests there may be a very large population on private land but permission to survey has not been obtained (Population # 60); 5) Aiken County, SC mega-population comprising 31 EOs – large numbers of likely relict trillium are visible from property line boundaries, and corroborated, in part, by aerial photography but landowner permission to survey has not been obtained (Population #61)

## Recovery Criterion #2 Assessment

Considering the 15 populations referenced in the Criterion #1 Assessment above, only seven rated as either high or moderate for both resiliency habitat factors: 1) habitat structure; and 2) threats. Of these seven, only four occur on formal conservation lands or are protected by formal conservation agreements – all in Georgia (Table 2, Service 2023). It is important to understand that populations may have a high or moderate overall resiliency score despite having a low or very low resiliency score in one or more of the of the individual factors.<sup>2</sup>

Given the number of threats to relict trillium that are now known, none of the populations meet the second recovery criterion as written. While some populations have protections from development and incompatible land use, all are susceptible to one or more threats that may cause extirpation of some populations or result in reduced resiliency such as herbivory, invasive exotic plants and animals, disease, fire, hydrologic impacts (sedimentation and erosion), and woody and/or evergreen encroachment in the mid-story and shrub levels (Table 2, Service 2023). A deeper examination of the Habitat-Threats factor in the SSA, indicates that 31 of 44 current populations were impacted substantially or extensively by the presence of at least one threat (Table 2). Even among the four protected populations with a high or moderate overall resiliency score mentioned above, each experienced negative impacts from invasive plants or deer herbivory. Active management (e.g., removing invasive exotic plants, fencing, fire breaks, law enforcement to prevent poaching, etc.) can reduce the occurrence and the impact of natural and illegal threats but will not eliminate them. Despite 17 of the 44 populations being protected, the management is generally sparse or non-existent, and most often occurs at a landscape level. Due to the small, isolated, and special nature of many rare plant occurrences, targeted rare plant restoration and management at a species-specific, micro-site level is frequently required.

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<sup>2</sup> In the SSA, a population resiliency score was determined by evaluating both Demographic and Habitat conditions. Additionally, two factors for both Demographic and Habitat conditions were developed and scored – for an overall total of four factors. The Demographic factors were: 1) Population Abundance; 2) Population Reproduction; and the two Habitat factors were: 3) Habitat Structure; and 4) Habitat Threats. The Habitat Threat factor also had four components: 1) invasive plant species; 2) feral hogs; 3) deer herbivory; and 4) hydrological impacts. Each was evaluated separately and then averaged. Scoring employed four condition classes (High, Moderate, Low, and Very Low) with each assigned a score from 1 to 4 (with a larger number indicating a more favorable score). An Overall Resiliency score was determined by summing the scores after the application of an importance weight for each factor. The Overall Population Resiliency Score for a given population was calculated as follows: (Abundance score\*0.33) + (Reproduction score\*0.17) + (Habitat Structure score\*0.17) + (Habitat Threat score\*0.33). Given the formulaic approach to scoring with various component levels and mathematical operations (i.e., averaging, summing, weighting) many populations had an Overall Resiliency score that differed substantially from one or more of its individual factors. For example, Population #37 Flint River-Mincey Tract has an Overall Resiliency score of Moderate but has a Very Low Resiliency score for Habitat Threats due to extensive presence of invasive plant species.

Table 1. Numbers of populations (by state) with High (H) or Moderate (M) Resiliency scores for Abundance, Reproduction, Habitat Structure, and Habitat Threat factors as analyzed in the SSA (Service 2023). Data are further presented for individual populations that scored High or Moderate for both demographic factors and both habitat factors. Populations scoring High or Moderate in ALL demographic and habitat factors are presented. Numbers followed by the letter “P” in parentheses indicate the number of populations in that category that are formally protected. For example: population abundance for AL is shown as 6 (1P) meaning that six of the populations occurring in Alabama scored High or Moderate for abundance (i.e., greater than 500 stems/individuals) and of those populations, one is protected.

| State        | #’s of Populations w/Abundance Score (H or M)<br><br><i>(Stem count &gt; 500 individuals)</i> | #’s of Populations w/Reproduction Score (H or M)<br><br><i>(Presence of buds, flowers, fruits, or recruits &gt; 5% of population)</i> | #’s of Populations w/Both Demographic Factors (H or M) | #’s of Populations w/Habitat Structure Score (H or M)<br><br><i>(Overstory canopy &gt; 50%; midstory, shrub layer &lt; 50% cover)</i> | #’s of Populations w/Habitat Threats Score (H or M)<br><br><i>(Invasive plants, hogs, deer browse, hydro damage ≤ 5% of site)</i> | #’s of Populations w/Both Habitat Factors (H or M) | #’s of Populations w/ALL Demographic and Habitat Factors (H or M) |
|--------------|---|---|--|---|---|--|---|
| AL           | 6 (1P)  | 7 (1P)  | 5 (1P)   | 5 (0P)  | 7 (0P)  | 4 (0P)   | 1 (0P)  |
| GA           | 19 (11P)  | 13 (6P)   | 10 (5P)  | 27 (15P)  | 15 (8P)   | 11 (5P)  | 6 (4P)  |
| SC           | 2 (1P)  | 0   | 0  | 2 (1P)  | 1 (0P)  | 1 (0P)   | 0   |
| <b>Total</b> | <b>27 (15P)</b>   | <b>20 (7P)</b>  | <b>15 (6P)</b>   | <b>34 (16P)</b>   | <b>23 (8P)</b>  | <b>16 (5P)</b>                                     | <b>5 (2P)</b>   |

Table 2. Numbers of populations (by state) threatened by invasive plant species, feral hogs, deer browse, and hydrologic impacts (such as sedimentation and erosion). Populations with extensive or substantial levels of these threats received Low (L) or Very Low (VL) Resiliency scores in the Habitat Threat analysis of the recent SSA. Some populations had multiple threats (Service 2023).

| State        | Total Number of Current Populations | Total Number of Current Populations with at least One Threat (L or VL) | Invasive Plants Number of Threatened Populations (L or VL) | Feral Hogs Number of Threatened Populations (L or VL) | Deer Browsing Number of Threatened Populations (L or VL) | Hydrological Impacts Number of Threatened Populations (L or VL) |
|--------------|-------------------------------------|--|--|---|--|---|
| AL           | 11                                  | 5  | 5  | 2   | 1  | 1   |
| GA           | 31                                  | 24   | 16   | 6   | 14   | 4   |
| SC           | 2                                   | 2  | 2  | 0   | 1  | 0   |
| <b>Total</b> | <b>44</b>                           | <b>31</b>  | <b>23</b>  | <b>8</b>  | <b>16</b>  | <b>5</b>  |

## **Biology and Habitat Summary**

The relict trillium is a small (e.g., less than 6 inches tall) perennial (spring ephemeral) herb. It is known from Alabama, Georgia, and South Carolina ranging across the upper Coastal Plain, Fall Line and lower Piedmont. It trends southwest/northeast from Montgomery/Dothan, Alabama, through Columbus/Albany and Macon, Georgia to North Augusta, South Carolina. It is found in 24 counties and is distributed across seven Level IV ecoregions (Figure 1) according to Griffith et al. (2001, entire). It occupies four hydrologic basins (Hydrologic Unit Code [HUC-6]), the Apalachicola, Altamaha, Choctawhatchee, and Savannah, and prefers mature hardwood forests in rich ravines and along stream terraces; over calcium-rich bedrock, such as amphibolite or limestone. It was listed as an endangered species due to its relatively limited range, few known populations, and threats to its habitat from human activities, particularly those associated with urban/suburban expansion and residential development.

The current and historical distribution of 102 relict trillium occurrences were overlaid onto HUC-6 basins (Figure 1). A recent (2020-2021) range-wide survey of 61 occurrences was conducted by the State Natural Heritage Programs with assistance from the Atlanta Botanical Garden, Auburn University, Augusta University, Troy University, and Fort Benning. An additional 18 occurrences had data current enough to be evaluated in the recent SSA. These 79 current occurrences were coalesced into 44 current populations<sup>3</sup> and categorized by resiliency of each population as described in the SSA Report (Figure 2; Service 2023).

The 2023 SSA delineated six Representation Units (RUs) based on the HUC-6 basins (Table 2; Service 2023). Additionally, two of the HUC-6 basins (i.e., Apalachicola and Savannah) were divided into east and west units due to the presence of major rivers that likely serve as a barrier to gene flow with studies showing greatest genetic diversity at the eastern and western extremes of the species range.

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<sup>3</sup> We delineated 61 population units from 102 total occurrences distributed across the range (i.e., 12 in AL, 45 in GA, and 4 in SC). Of the 61 populations, 17 were excluded from SSA analysis because they were considered historical (date of last observation prior to 2002), extirpated, experimental (safeguarding), or had data reliability issues (taxonomic uncertainty, unconfirmed presence, etc.), leaving 44 Current Populations (Service 2023). Delineation of individual population units used NatureServe's Habitat-based Plant Element Occurrence Delimitation Guidance (NatureServe 2020, p.1). For each relict trillium EO (and Object ID for South Carolina), we used the most conservative 1-km (0.62 mi) separation distance rule to delineate populations, noting that situations involving dispersal barriers could result in population delineations at even shorter distances. To apply this separation distance, we created a 0.5-km (0.31-mi) buffer around each EO and merged EOs into populations where these buffers intersected. This resulted in some isolated EOs being treated as distinct populations, while other populations are aggregates of several geographically clustered EOs. In situations where two buffered EOs intersected but were separated by one of the major rivers within the range, they were considered separate populations.



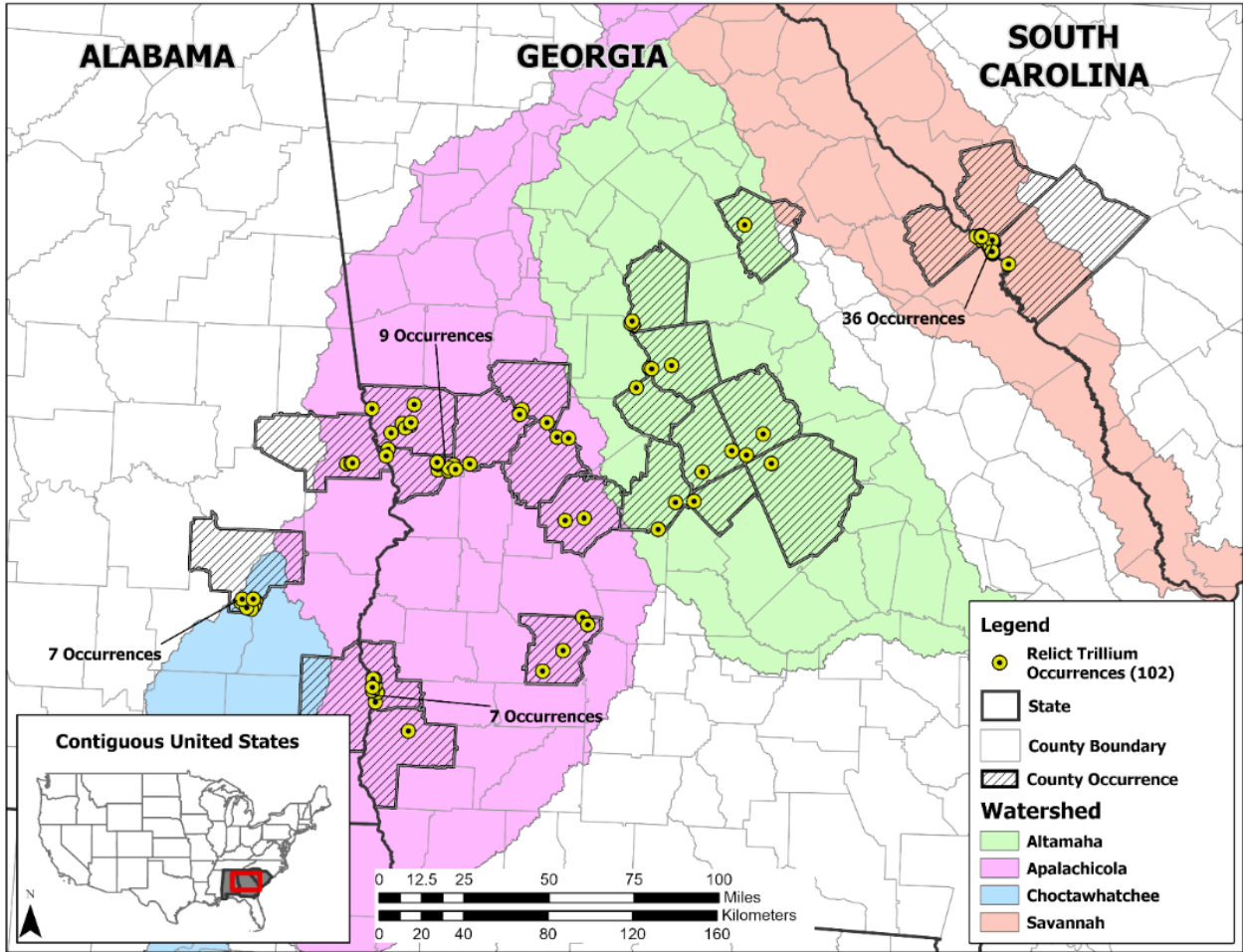


Figure 1. Watersheds (HUC 6) within Alabama, Georgia, and South Carolina with the general locations of relict trillium element occurrences.

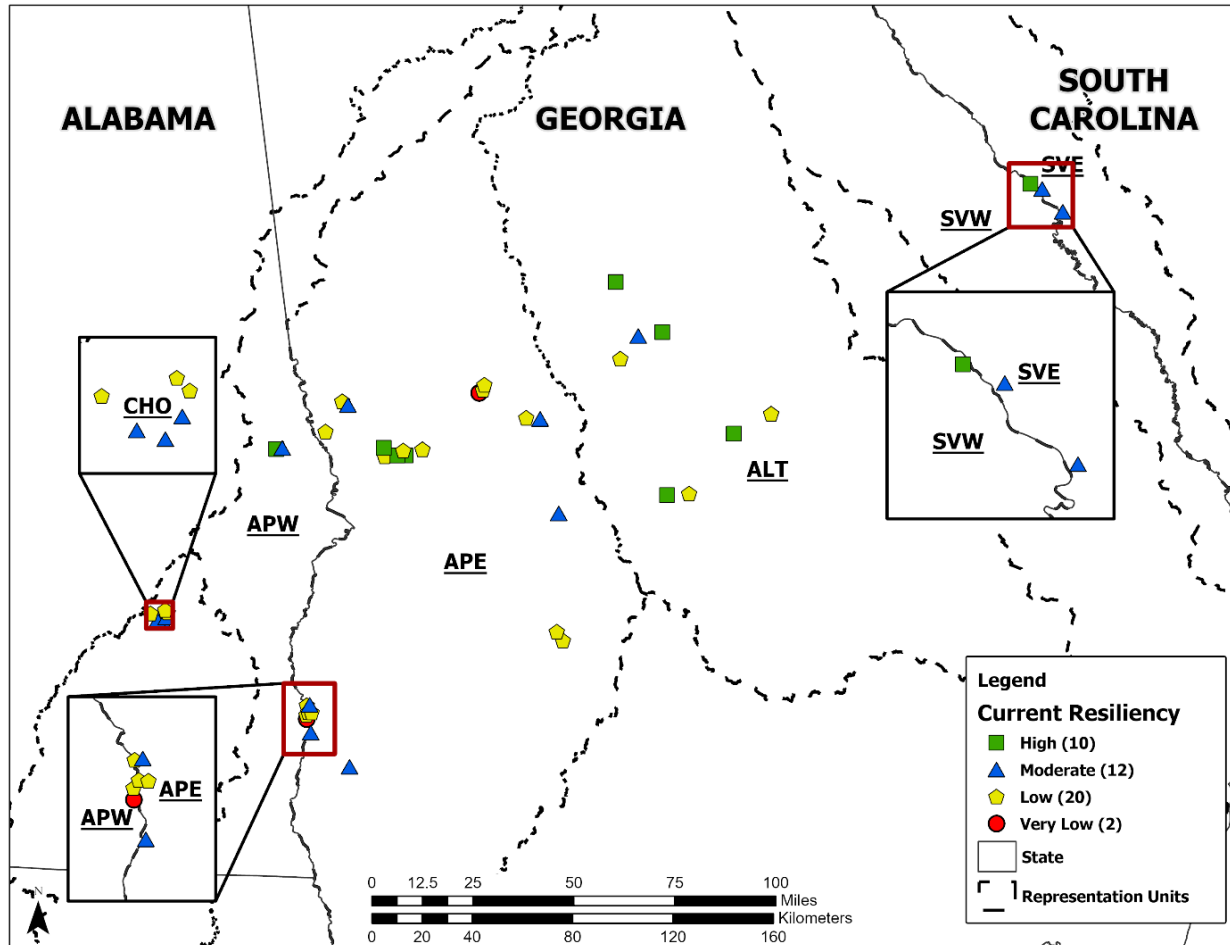


Figure 2. Current resiliency condition of 44 relict trillium populations distributed across the six representation units (RUs) in Alabama, Georgia, and South Carolina.

The current condition of each population was assessed by examining demographic and habitat factors. The analysis resulted in a condition score for each relict trillium population that was used to evaluate the species based on three aspects of population ecology (i.e., resiliency, representation, and redundancy). A summary of the assessment from the SSA Report (Service 2023) is found below. Details of methods and analyses can be found in the report.

*Resiliency* was assessed at the population level and describes the ability of a species to withstand stochastic disturbance. Resilient populations are better able to withstand disturbances, such as random fluctuations reproduction (demographic stochasticity), variations in rainfall (environmental stochasticity), or the effects of anthropogenic activities.

Of the 44 current populations of relict trillium, 10 populations were considered to have high resiliency and 12 to have moderate resiliency (50 percent combined were considered resilient; Table 3). Twenty (20) populations were estimated to have low resiliency and the remaining two (2) populations were estimated to have very low resiliency (50 percent

combined were considered to have poor resiliency). High and moderate resiliency was largely due to high abundance of individuals (more than 500 individuals) with most of these also exhibiting good quality habitat structure (closed hardwood canopy, open midstory, open shrub layer, and few competing groundcover components). Spring ephemeral habitat was considered negatively impacted by the substantial presence of evergreen trees and shrubs (more than 20 percent of their respective vegetative layer). Four (4) of the high and moderate resiliency populations had substantial evergreen presence. All populations had some evidence of non-native invasive plants, feral hogs, deer browsing and/or hydrologic impacts. Extensive impacts from invasive non-native plants and deer browse were the most prevalent habitat threats range-wide and were the primary factors affecting the low to very low resiliency populations. Of the 44 populations, 16 (36 percent) had extensive to substantial impacts from deer browsing and 23 (52 percent) had extensive to substantial impacts from invasive plant species (Table 2).

Table 3. Summary of resiliency condition classes for 44 relict trillium populations, noting if the population occurs on protected lands (State or Federal ownership or lands with a conservation easement) or not protected. (Recreated from Table 12, Service 2023). In some cases, only a portion of a population occurs on protected lands.

| <b>Resiliency Classes</b> | <b>Number of populations</b> | <b>Protected</b> | <b>Not Protected</b> |
|---------------------------|------------------------------|------------------|----------------------|
| High                      | 10                           | 5 (2 partial)    | 5                    |
| Moderate                  | 12                           | 4 (2 partial)    | 8                    |
| Low                       | 20                           | 7 (2 partial)    | 13                   |
| Very Low                  | 2                            | 1                | 1                    |
| <b>Range-wide total</b>   | <b>44</b>                    | <b>17</b>        | <b>27</b>            |

*Representation* describes the adaptive capacity, or ability of a species to adapt to changing environmental conditions over time and is characterized by the breadth of genetic and environmental diversity within and among populations. The more representation a species has, the more it is capable of coping with or adjusting to large-scale changes, such as climatic changes. We can best gauge representation by examining the breadth of genetic, phenotypic, and ecological diversity found within a species and its ability to disperse and colonize new areas.

To estimate current representation for relict trillium, we summarized the number and resiliency of populations across the six representation units (RUs). All six RUs have current (extant) relict trillium populations. The Apalachicola East RU has most of the populations with 22; with 9 having high or moderate resiliency and 13 having low to very low resiliency (Table 4).

Currently, relict trillium has 44 populations in varying levels of resiliency occurring in all 6 RUs. However, the number of populations is not evenly distributed across the RUs, putting some RUs at greater risk of loss of representation if populations become extirpated. Specifically, the RUs representing the western (Choctawhatchee and Apalachicola West)

and eastern (Savannah East) extents of the range are known to have the highest genetic diversity but have the fewest populations. Given the low to very low resiliency of 22 of the 44 populations (50 percent) and the additional 12 populations which are already considered historical, the species has reduced representation and, therefore, may have reduced capacity to adapt to changing environmental conditions.

Table 4. Relict trillium Representation Units (RUs), listed from the western to eastern extent of the range (e.g., Choctawhatchee (CHO), Apalachicola West (APW), Apalachicola East (APE), Altamaha (ALT), Savannah West (SVW), and Savannah East (SVE)). The number represents current populations in each resiliency class. An adjacent number within parentheses indicates populations on protected land. (Recreated from Table 13, Service 2023).

| Resiliency Class | CHO RU   | APW RU       | APE RU         | ALT RU       | SVW RU   | SVE RU   | Total RU  |
|------------------|----------|--------------|----------------|--------------|----------|----------|-----------|
| High             | 0        | 1            | 4 (3)          | 4 (1)        | 1        | 0        | 10        |
| Moderate         | 3        | 1            | 5 (2)          | 1 (1)        | 0        | 2        | 12        |
| Low              | 3        | 2 (1)        | 12 (4)         | 3 (1)        | 0        | 0        | 20        |
| Very Low         | 0        | 1            | 1 (1)          | 0            | 0        | 0        | 2         |
| <b>Total</b>     | <b>6</b> | <b>5 (1)</b> | <b>22 (10)</b> | <b>8 (3)</b> | <b>1</b> | <b>2</b> | <b>44</b> |

*Redundancy* describes the ability of a species to withstand catastrophic events (a rare destructive natural event or episode involving several populations or subpopulations). We can best gauge redundancy by analyzing the number and distribution of populations relative to the scale of anticipated species-relevant catastrophic events. The analysis entails assessing the cumulative risk of catastrophes occurring over time. For relict trillium, we determined the number and distribution of resilient populations across the species current range to measure redundancy.

To estimate species redundancy, the number, distribution, and resiliency of relict trillium populations were summarized across the six RUs. All RUs contain at least two current relict trillium populations. Currently, there are 22 high or moderate resiliency populations distributed across all six RUs. The greatest number of current populations (30) and the majority of the high to moderate resiliency populations (14) occur in the central portion of the range (Apalachicola East and Altamaha RUs; Table 4). The fewest number of populations occur in the eastern RUs (Savannah East and Savannah West).

There has been a reduction in redundancy over time for relict trillium within each RU and across the range. This is highlighted by half (22 of 44) of the current populations having low to very low resiliency. Further, all RUs except the Apalachicola West have historical populations. However, there are still 22 high to moderate resiliency populations distributed across the RUs and range of the species. All RUs have at least 2 high or moderate resiliency populations, except the Savannah West RU which only has one high resiliency

population. Therefore, we determined that relict trillium currently has moderate redundancy.

### **Threats (Five-Factor Analysis) Summary**

The status of a species is determined from an assessment of factors specified in section 4 (a)(1) of the Act. A summary of this assessment is detailed below. The recent SSA Report (Service 2023) contains a thorough review and assessment of threats to the relict trillium and offers additional detail on the magnitude, scope, and severity of limiting factors.

#### **Factor A - Present or threatened destruction, modification or curtailment of its habitat or range.**

Habitat loss and degradation remains the most significant limiting factor for the relict trillium. Relict trillium is found in habitat that is often well-suited for urbanization, infrastructure construction, and resource extraction activities such as timber harvest. In addition to direct habitat loss in areas that are not protected, urbanization can result in altered local hydrology from stormwater discharges to streams and reduce or remove floodplain habitat being used by downstream populations of relict trillium, reduced pollinator movements, and increased invasive species occurrences. Further indirect impacts from urbanization include fragmentation and loss of connectivity between populations and increased ancillary activities related to residential and commercial development such as construction and maintenance of linear infrastructure (e.g., roads and utility lines). Runoff from road rights-of-way often result in soil erosion and changes in water runoff patterns that can alter soil and moisture conditions, making habitat unsuitable. Detrimental land uses occurring adjacent to relict trillium populations may alter the natural hydrology of the site and/or influence the vegetation structure and composition.

There has not been a noticeable increase in the development of actual relict trillium occurrences or sales of properties containing relict trillium since the last status review (Service 2015). However, urban/suburban development across the relict trillium range continues at a steady pace and is accelerating in the metro areas around Columbus, Macon, and Augusta, GA, and North Augusta, SC. Development pressures are particularly intense in the North Augusta area where over 30 relict trillium occurrences intermingle with urban, light industrial, suburban, and large estate properties, as well as Interstate-20 and an extensive network of roads and highways, all within a very small area.

Management of roadside populations continues to be an issue for Georgia Department of Transportation (GDOT) and to a lesser extent for the South Carolina Department of Transportation. To make way for road-related construction projects, GDOT has relocated hundreds of plants from a Muscogee County roadside site to the Blanton Creek Wildlife Management Area, as well as approximately 400 plants from Jones County to the Oconee National Forest (ONF). Additionally, the Savannah Rapids Pavilion in Columbia County, Georgia relocated about 50 plants for a parking lot expansion to another part of their property along the Savannah River.

For those populations in non-urbanized areas, agriculture and silviculture pressures are most prevalent. Timber operations, including clear-cutting, have been extensive on and near relict trillium sites in Henry and Bullock counties, AL, since the 1990's. Wild and prescribed fire also pose a threat to relict trillium plants and its habitat depending on severity, seasonality, and return interval. Trillium populations on Fort Moore, GA and the ONF are close to populations of red-cockaded woodpeckers (*Leuconotopicus borealis*) where fire is a necessary management tool. However, both federal entities prioritize relict trillium conservation and manage the sites carefully (USDA Forest Service 2004, U.S. Department of Army 2022)

**Factor B - Over-utilization for commercial, recreational, scientific, or educational purposes.**

We have no indication that overutilization for commercial, recreational, scientific, or educational purposes poses a significant threat for the species. Collecting for gardens and horticultural collections can sometimes be a local problem.

**Factor C - Disease or predation.**

There is no significant known threat posed by disease. However, predation (herbivory) by whitetail deer pose a significant threat for the species. Over the last century, white-tailed deer (*Odocoileus virginianus*) population numbers have increased substantially. White-tailed deer can be a major threat to endangered and threatened plants in the Southeast including impacts to species density, diversity, and composition and plant development. Indirect impacts of deer density and herbivory, such as competition and facilitation of browse-resilient species, are a concern for preferred deer forage species. Extensive or substantial deer herbivory was observed in 36 percent of the 44 populations surveyed for the recent SSA Report (Service 2023).

In addition to white-tailed deer, herbivory from a cutworm caterpillar (*Cerastis tenebrifera*) has been documented at a site near the Savannah River Bluffs in Aiken County, GA, and has been reported as one of the principal threats at this site. The cutworm has not been verified to occur at other relict trillium sites and is not known to be a significant factor for relict trillium across its range.

**Factor D - Inadequacy of existing regulatory mechanisms.**

The recent SSA Report (Service 2023) contains a review of the state and federal laws and regulations which are most relevant to the relict trillium and its habitat. Within the three-state range of relict trillium, only Georgia has a rare plant protection law (Georgia Wildflower Preservation Act; O.C.G.A. § 12-6-170 — 12-6-176). Alabama, Georgia, and South Carolina all include relict trillium, along with other rare plants, in their State Wildlife Action Plans. The federal Endangered Species Act does not provide protection for listed plant species unless the plant occurs on Federal lands or protects plants when the activity is in violation of a state law when on private lands. Therefore, activities on private lands typically are not regulated. These limitations indicate that current regulatory mechanisms are not sufficient to protect the species from threats.

**Factor E - Other natural or manmade factors affecting its continued existence.**

Non-native invasive plants pose threats to trillium populations through competition for space and nutrients. Invasive plant species can outcompete native vegetation, sometimes forming

monotypic stands, and limit the available resources (nutrients, water, and sunlight) necessary for relict trillium to become established, juveniles to mature, and for individual plants to reproduce. Non-native invasive plants have been documented in 42 of 44 (95 percent) of relict trillium populations and have a substantial or extensive presence at 23 of 44 (53 percent) of the sites. Of particular concern are thorny olive (*Elaeagnus pungens*), Japanese stiltgrass (*Microstegium vimineum*), Chinese privet (*Ligustrum sinense*), Carolina cherry laurel (*Prunus caroliniana*), and kudzu (*Pueraria lobata*).

Feral hogs (*Sus scrofa*) occur throughout the Southeast and on most public conservation lands, where they are considered non-native invasive species. Hogs can negatively affect almost all aspects of ecosystem structure and function and are known to have significant impacts to native plant communities both directly (through consumption) and indirectly through rooting and soil disturbance. Impacts to relict trillium from feral hogs have been documented from 17 of 44 (39 percent) of populations, although substantial and extensive damage was observed at only 8 of 44 (18 percent) of relict trillium sites.

Impacts from future climate change through 2080 were analyzed in the recent SSA Report (Service 2023) using the USGS Earth Resources Observation Science Center FORE-SCE (FOREcasting SCEnarios) model. In the southeast United States, several climate change models have projected more frequent drought, more extreme air temperatures, increased precipitation (i.e., increased flooding and erosion), and more intense storms (e.g., frequency of major tornados). When considering future climate projections for temperature and precipitation where relict trillium occurs, warming is expected to be greatest in the summer, which is predicted to increase drought frequency, while annual mean precipitation is expected to increase slightly, leading to a slight increase in flooding events. Although there are several potential risks associated with long-term climate change as described above, there is uncertainty regarding the how relict trillium will respond to these risks.

## **Synthesis**

Relict trillium is a small perennial herb, native to 24 counties across the lower Piedmont, Fall line and upper Coastal Plain of Alabama, Georgia, and South Carolina. It occupies four HUC-6 basins (Altamaha, Apalachicola, Choctawhatchee, and Savannah). The 2023 SSA delineated six representation units (RUs). Relict trillium's known range has increased, and numbers of occurrences have quadrupled from 21 to 102 over the last 30 years. However, the increase is likely due to continued survey efforts and new finds, rather than an actual expansion of range or populations. The occurrences were grouped into 61 distinct populations, 44 of which are considered current. Of 44 current populations, 50 percent were considered to have high or moderate resiliency. Most of the populations are located at the center of the range. The RUs representing the western and eastern extents of the range are known to have the highest genetic diversity but have the fewest populations. In general, relict trillium has slightly moderate resiliency, moderate redundancy, and reduced representation. Seventeen populations occur, at least partially, on protected lands (one in AL, 15 in GA, and one in SC). Even in protected populations, it is unclear that broad landscape level management regimes will be adequate to address the pervasive and tenacious threats provided by exotic invasive plant species and deer herbivory. The relict trillium throughout its range is still threatened with habitat reductions from

development, quarrying, timber stand conversion, and road construction. These threats are expected to reduce the resiliency of the species in the future. Because of these ongoing threats, we recommend that relict trillium continues to meet the definition of an endangered species.

## **RECOMMENDED FUTURE ACTIVITIES**

A detailed discussion of recovery actions and criteria are presented in the recovery plan (Service 1991). Population #s listed below refer to the population numbering system developed in the SSA Report (Service 2023).

### **Alabama Populations:**

- Establish and improve landowner relationships
  - All populations
- Surveys needed
  - Populations #1 and 2 (Lee County)
- Invasive species control
  - Populations #6 (Bullock County); #10, 11, and 12 (Henry County)
- Deer herbivory and feral hog management
  - Populations #10, 11, and 12 (Henry County)

### **Georgia Populations:**

- Establish and improve landowner relationships
  - Populations #22 and 23 (Harris County)
- Surveys Needed
  - Populations #25 (Muscookee County); #45 (Jasper County)
- Invasive Species Control
  - Populations #37 (Taylor County); #47 (Jones County); #48 (Bibb County); #58 (Columbia County)
- Deer herbivory and feral hog management
  - Populations #14 and 15 (Clay County); #22 and 23 (Harris County); #32 and 33 (Talbot County); #34 (Upson County); #42 (Lee #46 (Jones County); # (Bleckley County)
- Formal protection of populations
  - Populations #22 and 23 (Harris County); #58 (Columbia County)

### **South Carolina Populations:**

- Establish and improve landowner relationships
  - Population #60 (Edgefield County)
- Surveys needed
  - Population #60 (Edgefield County); #61 (Aiken County)
- Invasive species and deer herbivory management
  - Population #61 (Aiken County)



- Formal protection of populations
  - Population #61 (Aiken County) – develop formal MOUs and Deed Restrictions on City of North Augusta properties, similar to that which currently exists for a portion of Riverview Park.

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## RESULTS / SIGNATURES

### U.S. Fish and Wildlife Service Status Review of Relict Trillium

#### Status Recommendation:

On the basis of this review, we recommend the following status for this species. A 5-year review presents a recommendation of the species status. Any change to the status requires a separate rulemaking process that includes public review and comment, as defined in the Act.

Downlist to Threatened

Delist:

*The species is extinct*

*The species does not meet the definition of an endangered or threatened species*

*The listed entity does not meet the statutory definition of a species*

No change needed

#### FIELD OFFICE APPROVAL:

**Field Supervisor, Georgia Ecological Services Field Office, Fish and Wildlife Service**

Approve \_\_\_\_\_

\* Since 2014, Field Supervisors in the Region have been delegated authority to approve 5-year reviews that do not recommend a status change.