

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

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



Photo by Pete Pattavina, USFWS

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

**5-YEAR REVIEW**  
**Relict Trillium (*Trillium reliquum*) Freeman**

**I. GENERAL INFORMATION**

**A. Methodology used to complete the review:** In conducting this 5-year review we relied on the best available information pertaining to historic and current distribution, life history, habitat, and potential threats of relict trillium. We announced initiation of this review and requested information in a published *Federal Register* notice with a 60-day comment period (70 FR 43171). Our sources include the final rule listing the species under the Act; the recovery plan; peer reviewed scientific publications; unpublished field observations by U.S. Fish and Wildlife Service (Service) and State biologists; unpublished survey reports; and notes and communications from other qualified biologists or experts. All recommendations resulting from this review are a result of thoroughly reviewing the best available information on relict trillium. Comments and suggestions regarding the review were received from peer reviewers from outside the Service (see Appendix A). No part of the review was contracted to an outside party.

**B. Reviewers**

**Lead Region:** Southeast Region: Nikki Lamp, 404-679-7118

**Lead Field Office:** Georgia Ecological Services, Field Office, Athens, Georgia: Jimmy Rickard, 706-613-9493 x223

**Cooperating Field Office:** Alabama Ecological Services Field Office, Daphne Alabama: Dan Everson, 251-441-5837 and Charleston Ecological Services Field Office, Charleston, South Carolina: Morgan Wolf, 843-727-4707, ext. 214

**C. Background**

- 1. Federal Register Notice citation announcing initiation of this review:**  
July 26, 2005: 70 FR 43171
- 2. Species status:** Stable. We have 72 Element Occurrences in 3 states, many of these have several thousand plants. There have only been 2 known human caused impacts to the species in the last 10 years (see Threats below).
- 3. Recovery achieved:** 2 (2 = 26%-50% species recovery objectives achieved)

- 4. Listing history:**  
Original Listing  
FR notice: 53 FR 10879  
Date listed: April 4, 1988  
Entity listed: species  
Classification: endangered
- 5. Associated rulemakings:** None
- 6. Review history:**  
Recovery Plan: 1991  
Recovery Data Call: 2013-1998  
5-Year Review:  
A species review was conducted for relict trillium in 1991 (56 FR 56882). In this review, the status of various species was simultaneously evaluated with no in-depth assessment of the five factors or threats as they pertain to the individual species. The Service was seeking new or additional information reflecting the necessity of a change in the status of the species under review. The notice indicated that if significant data were available warranting a change in a species' classification, the Service would propose a rule to modify the species' status. No change in the listing classification of this plant was found to be appropriate.
- 7. Species Recovery Priority Number at start of review (48 FR 43098):**  
8c. This number indicates a moderate degree of threat and a high recovery potential.

The degree of threat to relict trillium was judged to be moderate because the majority of known populations are unprotected from development or other land use changes and are not protected or managed to reduce threats from invasive plants and herbivores. Most of these populations occur in rural areas which have a relative slow rate of development.

Recovery potential was judged to be high because seven populations are on Federal lands, and four are on State lands set aside for conservation of relict trillium and other listed species or species of concern. Additionally four populations have easements that prevent changes in land use, two populations are maintained by a land trust and two populations are maintained by The Nature Conservancy.

Relict trillium is a species found in habitat that has high value for urban development, road construction, and silviculture. Conflict with economic development (federally-funded transportation and infrastructure projects) justifies the "c" part of ranking.

**8. Recovery Plan:**

Name of plan: Recovery Plan for Relict Trillium (*Trillium reliquum* Freeman)

Date issued: January 31, 1991

**II. REVIEW ANALYSIS**

**A. Application of the 1996 Distinct Population Segment (DPS) policy**

The Endangered Species Act defines species as including any subspecies of fish or wildlife or plants, and any distinct population segment of any species of vertebrate wildlife. This definition limits listing DPS to only vertebrate species of fish and wildlife. Because the species under review is a plant, the DPS policy is not applicable.

**B. Recovery Criteria:**

**1. Does the species have a final, approved recovery plan containing objective, measurable criteria?**

Yes, the criteria are based on number and location of protected self-sustaining populations.

**2. Adequacy of recovery criteria**

**a. Do the recovery criteria reflect the best available and most up-to-date information on the biology of the species and its habitat?**

No, the recovery plan has not been revised since it was published in 1991. There is significant information regarding threats from insects, disease, exotic invasive plants, feral swine (*Sus scrofa*), and large populations of white-tailed deer (*Odocoileus virginianus*).

**b. Are all of the 5 listing factors that are relevant to the species addressed in the recovery criteria (and is there no new information to consider regarding existing or new threats)?**

No. The original listing considered four relevant listing factors which are addressed in the recovery plan. However, there is a substantial amount of new information regarding those four listing factors. The fifth listing factor (Factor B-overutilization) remains not relevant.

**2. List the recovery criteria as they appear in the recovery plan, and discuss how each criterion has or has not been met, citing information.**

**For threats-related recovery criteria, please note which of the 5 listing factors are addressed by that criterion. If any of the 5-listing factors are not relevant to this species, please note that here.**

**Recovery Criteria:** *“These recovery objectives are considered an interim goal. Because of the lack of specific data on genetic diversity, biology, and management requirements of the species, the recovery objectives may be changed as additional information is acquired. This information may permit refinement of the estimate of the number of populations required to ensure the continued survival of relict trillium...”*

1. *“The species will be considered for delisting when there are 12 populations (2 in Alabama, 7 in Georgia, and 3 in South Carolina) that are self-sustaining and occur on sufficiently large tracts to ensure their perpetuation with a minimal amount of active management.”*

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 to constitute a self-sustaining population and 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.

Protected populations are considered to be those populations that are on Federal land (U. S. Army and U. S. Forest Service [USFS]) where section 7 provisions apply, on State lands (Georgia and South Carolina) that have been set aside for the conservation of relict trillium and other listed species or species of concern, or on land covered by a conservation easement that prohibits, in perpetuity, those activities that are not compatible with relict trillium conservation.

Data from the Alabama Natural Heritage Program shows that there is one protected population in Alabama on Army Corps of Engineers land. The South Carolina Department of Natural Resources reports that part of two populations in South Carolina are protected; one on land owned by the South Carolina Department of Natural Resources and one on property on land owned by Central Savannah River Landtrust. At least 12 populations are protected in Georgia; three on Georgia Department of Natural Resources

(GADNR) lands (Patrick 2004); one on land owned by the Georgia Department of Transportation; one enrolled in a state conservation easement; five at Fort Benning (Thornton 2005); one on USFS land (two element occurrences but one population) (Patrick 2005); one on Army Corp of Engineer property; and two on property on which The Nature Conservancy (TNC) has a conservation easement.

In 2011, Caspary and Rickard conducted population estimates on 19 element occurrences that are owned by potential conservation partners (i.e. The Nature Conservancy, Department of Natural Resources, Department of Defense or landtrust). Seven populations have been identified in Georgia with well over 500 reproductive individuals (Mincy, 95% CI pop est.: 9194; Kendall Creek North, 95% CI pop est.: 532; Montezuma Bluffs, 95% CI pop est.: 12420, Prevatt A, 95% CI pop est.: 2746; Prevatt B, 95% CI pop est.: 994; Potato Creek, 95% CI pop est.: 1013; and Shellstone Creek, 95% CI pop est.: 933), one site in Alabama (Power house, 95% CI pop est.: 785) and one site in South Carolina (Greystone, 95% CI pop est.: 1089) (Caspary 2013). These surveys did not include visits to Oconee National Forest (ONF) populations, which were being concurrently surveyed by the U.S. Forest Service Office in Athens, GA. Preliminary data of the ONF population provided by USDA-Forest Service Forestry Sciences Laboratory, shows an estimate of 135,594 reproducing individuals for the area (Caspary 2013). There are 5 additional populations with conservation potential that had the high end estimate greater than 500 reproductive individuals, however, because their low end estimate was below 500 they are not considered large enough to be self-sustaining.

While these all represent robust populations of relict trillium, some of these sites are being threatened by invasive species. Of the Georgia sites, Prevatt A seems to be experiencing significant increases in feral hog damage which is impacting the site quality and Prevatt B and Shellstone creek appears to have hog damage that could become more detrimental to the existing population over time. Kendall Creek North, a population located on Fort Benning, is estimated to have just enough reproducing individuals using the 95% confidence interval, however, this site is experiencing invasion from *Lonicera japonica* that will likely compete with the existing relict trillium population. Mincy, Kendall Creek North, Montezuma Bluffs, Potato Creek, Power House and Greystone have invasive species on site including *Ligustrum sinense*, *Lonicera japonica*, *Microstegium vimineum*, *Elaeagnus pungens*, *Elaeagnus umbellata*, *Rosa multiflora*, *Melia azedarach*, and *Pueraria Montana*, with *Ligustrum sinense* and *Lonicera japonica* posing the greatest threat by far to existing populations. Proper management efforts must be undertaken to ensure that these sightings remain self-sustaining.

We have more than the number of populations needed in Georgia to meet this criterion, but not in Alabama or South Carolina. Therefore, the first recovery criterion, which addresses listing factors A, D, & E, has not been fully met.

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.”* (USFWS 1990, p.11).

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 such as herbivory, invasive exotic plants and animals, disease, and fire. Active management (e.g., removing invasive exotic plants, fencing, fire breaks) can reduce the occurrence and the impact of natural and illegal threats but will not eliminate them.

Fire is a valuable tool for managing the landscape; however, fire management can adversely impact trillium populations. Trillium occurs in hardwood coves, mesic slopes and flood plains that are not considered fire prone. Trillium populations at Fort Benning and on the Oconee National Forest are in close proximity to populations of red-cockaded woodpeckers where fire is a necessary tool. Most prescribed fire management is conducted in the winter and early spring when fire behavior is more predictable. The Trillium rhizome sends up its shoot in late January or early February, it works through the duff layer, and emerges in mid to late February, if a fire burns over a trillium population and consumes the duff layer then trillium will not flower that year.

Furthermore, seeds germinate in the duff layer. The rhizome spends several years (5-10 years) pulling down through the duff layer until it reaches mineral soil. A hot fire that consumes the duff layer would destroy several years of recruitment and frequent fires could eliminate recruitment altogether.

Many State lands are managed to conserve Trillium, generally by preventing land use changes. However State Parks or Natural Areas, have no budget for the control of invasive species and therefore no plan to deal with invasive species. Furthermore several of these sites prohibit hunting, resulting in an unnaturally high population of herbivores. Other properties with a high degree of conservation potential have severe hog problems and in some cases hogs are encouraged.

The second criterion, therefore, has not been met. This criterion addresses listing factors A, C, D, & E.

## **C. Updated Information and Current Species Status**

### **1. Biology and Habitat**

**a. Abundance, population trends:** In 1988, the relict trillium was listed as federally endangered under the Endangered Species Act of 1973 (USFWS 1988). A member of the Trilliaceae or Melanthiaceae family, but sometimes listed in the Liliaceae, this perennial herbaceous species can be identified by its whorl of three leaves that sit on an S-shaped hairless stem (Chafin 2007). The ovate to elliptic leaves have distinctive shades of light green, dark green, bronze-green, and dark purple and will often show a silver stripe down the midvein (Patrick et al. 1995). At times it can resemble *Trillium decumbens* Harb., but can be distinguished by its anther sacs that are intorse with acutely tipped connective tissue or “beaks” that extend 1-2.5 mm beyond the anther sacs. Carrion insects, including fly and beetle families, attracted to the fetid smell of the green to maroon sepals, are believed to be the dominant pollinators, while ants are noted as important dispersal mechanisms for the species (Folkerts et al. 1987; Waddell 2006). Relict trillium blooms from mid-March through April and is known to occur in rich mixed deciduous forested slopes, bluffs, and stream flats (Case and Case 1997). It grows along the fall line in Alabama, Georgia, and South Carolina.

Relict trillium has proven to be more abundant than was realized when the recovery plan was written. There were 21 known populations in 1990 (USFWS 1990) and there are at least 72 known populations in 2014 as well as other reported occurrences yet to be confirmed. There is no organized effort to monitor all known populations for population trends. However, annual sampling has been conducted by Conservation Branch technicians at Fort Benning, Muscogee County, Georgia and the Savannah River Bluffs Heritage Preserve in Aiken County, South Carolina.

Population trends on Fort Benning are monitored annually by counting the plants in five permanent plots in each of five populations. Data from 2002-2009 indicated two populations were increasing and three were stable. These are static plots that may not accurately represent the population trends.

Savannah River Bluffs Heritage Preserve data for 2004 showed a total of 2,805 plants counted, an increase in the number of flowering plants of 1.7% over 2003 and 3.6% over 2002 (Gordon 2004). Gordon (2004) attributed above normal rainfall in 2003, preceded by several years of drought, as the likely reason for an increase in flowering.

**Genetics:** Relict trilliums typically take five to seven years to reach reproductive maturity, but can take as much as 10 years or more before reaching the reproductive stage (Ohara 1989). These trillium species can be very long-lived for a herbaceous species (some are suspected of being up to 100 years old (Chafin 2009)) and are known to reproduce infrequently by seeds and by clonal spread. A study by Gonzalez and Hamrick (2005)



found strong genetic differentiation among sites. In their research, a relationship could not be established between population size and genetic diversity and genetic diversity and gene flow across populations was relatively low. They did discover a statistically significant trend of decreasing heterozygosity from east to west, particularly when populations west of the Chattahoochee River were excluded from analyses, because *Relict trillium* populations at either margin of the geographic range had the highest proportion of polymorphic loci.

Gonzales and Hamrick (2005) concluded that there is no appreciable gene flow among relict trillium populations and that historically there was little genetic interchange between populations. They contend that the rarity and isolated populations characteristic of the species are of ancient origin rather than due to recent habitat fragmentation following European colonization and this plant, could be viewed as a species composed of a number of ancient and genetically diverse populations. Gonzales and Hamrick (2005) results also suggest that the Alabama and Georgia populations, separated by the Chattahoochee River acting as an effective barrier to genetic interchange, may represent different historical lineages, perhaps originating from separate glacial refugia on opposite sides of the Chattahoochee River.

The recovery plan was developed without benefit of information on the population genetics of relict trillium. Considering the genetic variability between populations, the likelihood that the genetic variability between populations is of ancient origins, and the genetic differences between Georgia populations and the less numerous Alabama populations (Gonzales and Hamrick 2005), the number and distribution of protected populations necessary for downlisting or delisting should be reevaluated to determine the number and distribution required to preserve the genetic variability of the species.

**c. Taxonomic classification:** No new information is available on taxonomy of this species. ITIS states that *Trillium reliquum* is an accepted taxon (Integrated Taxonomic Information System 2014).

**d. Spatial distribution:** There has not been a range-wide attempt to systematically survey potential habitat for relict trillium. Some Department of Defense and State lands have been systematically surveyed and The Nature Conservancy has searched selected private holdings in Alabama and Georgia, finding three additional populations in recent years.

In the recovery plan, relict trillium populations were listed in three counties in Alabama, two in South Carolina, and six in Georgia (USFWS 1990). The number of counties with known populations has not changed in Alabama and South Carolina, however, the Georgia Department of

Natural Recourses reports that the number of occupied counties has tripled in Georgia.

**e. Habitat or ecosystem conditions:** Urbanization and road improvement projects are two of the factors that destroy or degrade habitat. Human population growth is a primary factor in encouraging all types of development. Human population growth within the range of relict trillium has been increasing since 1990 (U. S. Census Bureau 2006a) and is expected to continue through at least the year 2020 (U. S. Census Bureau 2006b). Habitat fragmentation due to development has also been a concern although the work by Gonzales and Hamrick (2005) indicates that populations have typically been isolated since long before European colonization, and that the species has adaptations to offset the genetic disadvantages of isolation and rarity (Heckel and Legge 2007).

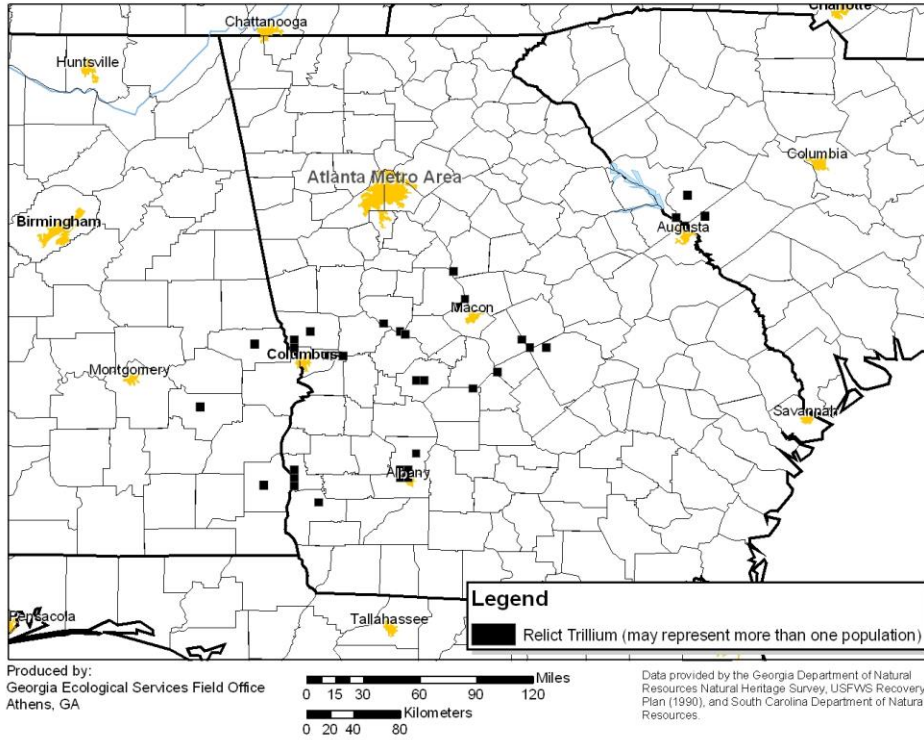
Exotic invasive species degrade a number of relict trillium populations and associated habitat. Honeysuckle (*Lonicera japonica*) is of particular concern (Patrick 2005; Thornton 2005) because it is so widespread and can reduce recruitment and suppress populations (Heckel and Leege 2004). Kudzu is another exotic invasive vine that can suppress populations (Heckel and Leege 2004). Privet (*Ligustrum* spp.) has also been identified as a problem at a number of sites (Schotz 2006).

Relict trillium distribution is shown in Figure 1 and summaries of verified populations in each State are found in Tables 1.

**Figure 1: Range map of relict trillium**



Relict Trillium (*Trillium reliquum*) populations in Alabama, Georgia, and South Carolina



**Table 1. Extant relict trillium element occurrences known from Georgia.** Data courtesy of GDNR, as of September 2004 (updated September 2014) note; some element occurrences may be part of a larger population.

Site Name and/or Metapopulation Number	County	Date Discovered/Last Observed	Size and/or Vigor	Ownership	Threats
Old Augusta Canall	Columbia	1848/2012	Moderate, 100-200 clumps with greater than 2,000 plants. Formerly larger	Mixed, Public (County) and Private	Aggressive exotics, one parcel slated for development and county constructed pavilion on top of habitat, also severely impacted by clear-cutting circa 1990
Standing Boy WMA	Muscogee	2010/2012	Extensive hardwood cove habitat with two separate populations. est. 142 reproductive stems 23162 mature stems, 26847 juvenile stems 95%CI, (Caspary 2013)	State owned	None documented

Mulberry Creek	Harris	2010/2010	5,000 acres managed for timber production, hardwood bluff habitat >5,000 stems	Private ownership	Real estate development and timber harvest are both serious threats
Lower Blue Springs Rd	Harris	2010/2010	Extensive hardwood cove habitat, >5,000 stems	Private	Real estate development or timber harvest
Upatoi Cr	Talbot	2007/2010	Floodplain hardwood habitat, >10,000 stems	Private ownership under TNC conservation easement (B. Slay, TNC, pers. comm., 2009)	Extensive hog population
Juniper Station	Talbot	2010/2010	Floodplain habitat with 100-200 stems	Private ownership under TNC conservation easement (B. Slay, TNC, pers. comm., 2009)	Extensive hog population
Mincey	Taylor	2010/2013	Extensive hardwood bluff along the Flint river (.9194 95% CI (Capary 2013) stems	400 ac of privately owned property with a conservation easement	Extensive privet infestation
Savannah River Bluffs	Columbia	1984/2010	Likely under 50 clumps more than 1,000 plants	Private	Development in 2009 has fragmented this habitat but has preserved remaining habitat as green space.
Dry Creek	Early	1947/2000	Moderate, larger than documented in USFWS (1990) Recovery Plan	Private	Increase in vine strata due to 1983 tornado disturbance to tree canopy
Upper Cemochechobee Creek	Clay	1947/1997	Large, at least 200 plants (Allison 1988, USFWS 1990)	Timber Company and Private Ownership	Portion of site protected under registry of The Nature Conservancy; aggressive exotics encroaching
Town Branch and Lower Cemochechobee Creek	Clay	1976/1997	Large, 1988 survey observed in excess of 1,000 stems	Mixed, partly owned by City of Fort Gaines and private family.	No apparent, immediate threats. Family on registry of The Nature Conservancy.
Point Comfort, South Ravine	Columbia	1985/2000	Small, 30-40 plants (2,000 estimate)	Private	Near-complete infestation of aggressive exotics; site likely to be developed in a few years, as of 2000.
Point Comfort North Ravine	Columbia	Unknown	Unknown, at least several dozen	Private	Sold to a developer, future status unknown
Pobiddy Road	Talbot/Upson	1979/2012	Small on Talbot bank, large on Upson hammocks and south-facing ridge (1293 reproductive stems, 95% CI when combined with Potatoe creek EO(Capary 2013)	Mixed; private in Talbot, Upson is under state ownership and will be developed as a State Natural Area	Talbot side timbered and burned in 1987; Upson side apparently secure but roadway may disturb some stems growing on bridge approaches near boat ramp, likely in 2006. Sever privet invasion
Mossy Dell	Lee	1988/1999	Uncertain, seemingly moderate to large with patchy distribution	Private	Some site protection b/c one landowner registered with The Nature Conservancy. No serious, immediate threats apparent.
Montezuma Bluffs	Macon	1988/2010	Hardwood bluff	Public (State Natural	Impacts from aggressive

North			habitat (18,118 reproductive stems 95%CI for both EO's (Caspary 2013))	Area)	exotics, including hogs; also localized impacts from off-site agricultural runoff
Montezuma Bluffs South	Macon	1988/2010	Hardwood bluff habitat (see comment above)	Public (State Natural Area)	Threats from soil erosion and disturbance by feral hogs.
Upper Ledbetter Branch	Clay	1988/1988	Moderate with at least 300 plants (Allison 1988)	Private	Japanese honeysuckle present but not indicated as major threat.
Lower Ledbetter Branch	Clay	1988/1988	At least 90 plants, but may be an underestimate	Unknown	None documented, perhaps on Army property.
Maidenhair Bluffs N	Clay	1988/1988	Small or unknown, at least 23 plants	Private	No immediate threats documented.
Maidenhair Bluffs	Clay	1988/1988	Perhaps 70 plants	Private	No immediate threats documented.
Lilliput Gorge	Clay	1988/1988	About 90 plants among three subpopulations	Unknown	Japanese honeysuckle present in floodplain, but perhaps not an immediate threat.
Colaparchee Creek	Bibb	1991/2003	Large, at least hundreds of plants	Private	Invasives present, lots of nearby development, sewer line recently proposed through area (2003), but withdrawn for various reasons.
Colaparchee Creek at I-475	Bibb	2000/2000	At least 25-30 clumps and extending upstream on creek	Mostly private with partial ownership by GDOT	Aggressive exotics a problem, interstate divided population.
Kendall Creek	Muscogee	1991/2009	741 reproductive stems 95%CI (Caspary 2013)	U.S. Military/Fort Benning	No immediate threats documented.
Kendall Creek South	Muscogee	1998/2009	See comment above	U.S. Military/Fort Benning	No immediate threats documented.
Randall Creek South	Muscogee	1991/2009	At least 250 stems	U.S. Military/Fort Benning	No immediate threats documented.
Randall Creek North/13	Muscogee	2009	388 reproductive stems 95%CI (Caspary 2013)	U.S. Military/Fort Benning	In 2010, 1,250 stems translocated because of a military construction project.
Randall Creek at Passmore	Muscogee	1998/2009	Moderate but extensiveness unknown, at least a few hundred plants	Private	Threats uncertain, sewer line impact previously part of section 7 consultation.
Butler Creek Tributary Woods	Jones	1992/1992	Estimated 80-100 plants	Private	No immediate threats; private landowner committed to conservation.
Butler Creek Mouth	Jones	1992/1993	Estimated 80-100 plants	Private	No immediate threats; private landowner committed to conservation.
Wilson Woods	Upton	1993/2000	Small, less than 10 flowering plants observed	Private	No immediate threats documented.
Shellstone Creek	Bleckley	1995/1998	1303 reproductive individual 95%CI (Caspary 2013)	Public/State Wildlife Management Area	Threatened by clear-cutting of adjacent area, site logged prior to fee-simple purchase by State in 2004. Extensive hog damage (Caspary 2013)
Big Creek	Houston	1995/1995	Small, several dozen plants	Private	Site impacted by severe clear-cutting, road building, and potential

					residential.
Pratts Creek Tributary	Jones	Last observed 1993	Unknown	Private	Plants in narrow, hardwood stream buffer. Upland severely herbicided and impact to hardwoods—pines invading.
Pratts Creek Bluff/18	Jones	1995/1995	350-400 stems estimated	Private	No immediate threats documented.
Baker Creek	Muscogee	1998/2010	Floodplain habitat est. 399 reproductive stems 95%CI (Caspary 2013)	U.S. Military/Fort Benning	None documented.
Potato Creek Ravines	Upton	1996/2004	1293 reproductive stems 95%CI when combined with Pobidy Rd EO (Caspary 2013)	Public/GDOT with future management by GDNR	Nepal grass competing with many young plants on back levy of Potato Creek, a few stems will likely be disturbed by future stream restoration (2004).
Huling Preserve	Harris	1998/1998	Unknown	Mixed; Private and timber company	No immediate threats documented, landowner interested in conservation.
Little Branch	Harris	1998/1998	Unknown, but at least hundreds with dozens in flower	Private	No immediate threats documented.
Kolomoki Creek Near Mouth	Clay	1991/1991	Unknown or small, less than 50 flowering plants observed in cursory survey	U.S. Government/USACE	No immediate threats documented.
Little Branch Amphibolite Bluffs	Harris	1998/1998	Unknown, over large area	Private	Road and home built within heart of site.
Jordan Tract South	Muscogee	1998/1998	Small, 10-12 plants	Private	Planned for a residential development.
Jordan Tract North	Muscogee	1998/1998	Small, 20-30 plants widely scattered	Private	Planned for a residential development.
Buck Creek Bluffs	Macon	2000/2004	Unknown. Sparse but spatially extensive	Private	Was part of Weyerhaeuser, Inc. but likely sold in 2003-2004 in large divestment effort.
Snow's Pond	Twiggs	2001/2001	Less than 50 plants observed	Unknown	No immediate threats documented.
Turkey Creek	Laurens	2001/2001	Sparse but spatially extensive. At least 100 clumps	Private	No immediate threats documented. On property leased to hunting club.
Turkey Creek-Allentown	Wilkinson	2001/2001	Small, less than 50 plants observed	Unknown	No immediate threats documented.
Prevatt A		2012	Est. 3814 reproductive stems 95%CI (Caspary 2013)	Privately owned with ACUB easement	Extensive hog damage (Caspary 2013)
Pravatt B		2012	Est. 1621 reproductive stems 95%CI (Caspary 2013)	Privately owned with ACUB easement	Extensive hog damage (Caspary 2013)

Big Indian Creek	Houston	2014	Limestone bluff with hardwood overstory. Several thousand plants in to aggregations	Private	Road widening
Chokee Creek	Lee	2014	Limestone Bluff, beech magnolia overstory	Private	none
Riverbluff at Fickling Mill	Taylor	2004/2004	Unknown due to late season survey	Private	No immediate threats. Exceptional habitat, north-facing bluff with <i>Croomia</i> , <i>Panax</i> and <i>Asarum canadense</i>
Horse Trail (Patrick 2005)	Jasper	2005/2010	Greater than 100,000 reproductive stems estimated by the Forest Service	US Forest Service	No immediate threats documented.
Beech Ravines (Pattavina 2006)	Jasper	2006/2010	See comment on Horse Trail above.	US Forest Service	No immediate threats documented.

**Table 2. Extant relict trillium populations known from Alabama.** Unpublished Data Provided by Al Schotz (2006).

Site Name and/or Metapopulation Number	County	Date Discovered/Last Observed	Size and/or Vigor	Ownership	Threats
Population 1-5	Bullock	Unknown/1990	No information	Private	No information
Population 6	Henry	Unknown/March 2000	Ca. 350 plants on 0.5 acre	Army Corps of Engineers	<i>Ligustrum sinense</i>
Population 7	Lee	Unknown/1988	No information	Private	Residential development
Population 8	Henry	Unknown/1993	No information	No information	No information
Population 9 Power House Road	Henry	Unknown/March 2000	2093 reproductive stem 95%CI (Caspary 2013)	Part Army Corps of Engineers, part private	<i>Ligustrum sinense</i>
Population 10	Lee	2006/March 2006	Ca. 65-75 plants	Private	<i>Lingustrm sinenxe</i> , <i>Poncirus trifoliata</i>

**Table 3. Extant relict trillium populations known from South Carolina.** Data courtesy of South Carolina Department of Natural Resources, data as of September 23, 2004. (Moule 2006a; B. Pittman, SCDNR, botanist, pers.comm., 2006)

Site Name and/or Metapopulation Number	County	Date Discovered/Last Observed	Size and/or Vigor	Ownership	Threats
Hazel Grove Natural Area/001	Aiken	1946/1990	Unknown, locally abundant	Not indicated, likely mixture of	Not indicated

SC				private, municipal, and State (USFWS 1990)	
002 SC	Aiken	1985/1985	Abundant	Not indicated	Not indicated
003 SC	Edgefield	1984/1992	Not indicated	Not indicated	Not indicated
No-name Branch Natural Area/004 SC	Aiken	1987/1990	Not indicated	Not indicated, likely State-owned(?)	Not indicated
No-name Branch Natural Area/005 SC	Aiken	1990/1990	Large	Not indicated	Threatened by residential development.
Savannah River Bluffs Heritage Preserve/006	Aiken	1994/2004 (Gordon 2004)	2,805 plants counted in 2004 survey (Gordon 2004)	State-owned	Deer herbivory and cutworms are problems (Gordon 2004, Moule 2006a)
007 SC	Aiken	2001/2001	1621 reproductive stem 95%CI (Caspary 2013)	Central savannah River Landtrust	Hazel Langrall <hazel@csrlt.org> (706)312-5263, central savannah river landtrust. Extensive invasive invasion (Caspary 2013)

f. **Other:** None

2. **Five-Factor Analysis (threats, conservation measures, and regulatory mechanisms):**

a. **Present or threatened destruction, modification or curtailment of its habitat or range:** Three populations are known to have been damaged or reduced in size by development, road construction and timber operations since 2004. It is not known how many other populations may have suffered damage because there is no organized effort to monitor populations on private lands. Negotiations were recently (2006) completed between TNC and two timber companies to minimize damage to one Georgia population and one Alabama population that are scheduled to be clear cut.

Part of a population in South Carolina is slated for development, and with the owners permission, over 2,000 plants were translocated to safer sites on public and other private land (Moule 2006b). Since most populations are not monitored on an annual basis it is not known how many populations range-wide are at imminent risk from development or timber harvest.

The Pobiddy Road and Potato Creek Element Occurrences represent one population that was impacted by a bridge replacement and road maintenance in 2005 (U.S. Fish and Wildlife Service 2005). Impacts caused by the Georgia Department of Transportation where mitigated by the State of Georgia purchasing these sites for conservation.



The Randal Creek North element occurrence was severely impacted by road construction in 2007, with more than 1200 stems and 3 acres of habitat destroyed (U.S. Fish and Wildlife Service 2007). Approximately 1250 rhizomes of relict trillium were rescued from the site by the Georgia Plant Conservation Alliance. Two safe guarding sites were identified, and the plants were divided and established on those sites.

Six hundred of the rhizomes were transplanted to Blanton Creek Wildlife Management Area. This site is owned by Georgia Power and managed by the Georgia Department of Natural Resources. Limited monitoring has shown that the plants have persisted with limited loss, however there has not been any documented recruitment at this site. Additional monitoring is needed, without recruitment, this site will fail.

Another 600 rhizomes were transplanted onto a large tract owned by Callaway Gardens for safe guarding. Due to financial constraints Callaway Gardens divested this property. The current property owner manages intensively for deer and established a corn feeder in the middle of the translocation site. Many plants have been destroyed by tractor and ATV traffic. The corn feed is very effective at attracting a large number of deer and turkey which opportunistically browse any green vegetation in the area. Most surviving plants suffer from intensive browse pressure due to the increased concentrations of deer and turkey visiting the feeding site. This safeguarding site is a complete failure.

Approximately 50 rhizomes were split between the State botanical Garden and the Chattahoochee Nature Center to be grown in their educational display beds.

**b. Over-utilization for commercial, recreational, scientific, or educational purposes:** Recreational use poses no known significant threats. Minor inadvertent damage caused by a horse trail to a population in the Oconee National Forest, Georgia has been reported (Patrick 2005) and minor damage (trampling) to a South Carolina population was caused by individuals playing Frisbee golf in a municipal park. The problem was subsequently corrected by moving one of the Frisbee golf “holes” and building a fence (Zimmerman 2005).

This plant is not known to be used in horticultural trade and over utilization is not thought to be a threat.

**c. Disease or predation:** No diseases, insects, or herbivores were mentioned as a concern in the recovery plan. Species subsequently reported as detrimental to relict trillium include white-tailed deer in Georgia (Patrick 2004) and South Carolina and an as yet unidentified

cutworm (Lepidopteran moth larvae) affecting populations in South Carolina (Moule 2006a).

Methods of dealing with white-tailed deer damage include exclusion fencing and increasing deer hunting to reduce the deer population. The lack of reported deer damage at locations that have an effective deer hunting program, such as Fort Benning, may indicate that relict trillium is not a preferred food but is acceptable when high density deer populations reduce the availability of preferred plants.

Moule (2006b) believes that the relict trillium population is declining at Savannah River Bluffs due to an unknown cutworm. Efforts are being made to identify the unknown cutworm so a management strategy can be developed.

Feral swine are also a concern because of their intensive rooting activity. While it is not known to what degree swine target relict trillium rhizomes for food, their extensive rooting may damage or uproot trillium. It is also not known how long it may take for populations to recover from hog rooting.

Disease has been reported to affect one relict trillium population. Gyer (pers. comm., 2006) observed diseased specimens at one of the Fort Benning, Georgia populations. Plants had lesions on the leaves apparently caused by the fungus *Ciborinia trillii* as tentatively identified by Dr. Lori Carris of Washington State University. Effort will be made to collect diseased leaves to be forwarded to Dr. Carris for confirmation. Moule (2006) reported an apparent disease in South Carolina specimens, but Martin (2006) found no evidence of disease and concluded that early senescence, probably caused by dry weather, was the likely cause.

**d. Inadequacy of existing regulatory mechanisms:** State laws and regulations in Alabama, Georgia, and South Carolina do not provide protection for relict trillium habitat on private land (GADNR 2006). Since the Endangered Species Act (ESA) provides very limited protection for listed plants and their habitat on non-Federal land, most populations are at risk from development and other land use changes. At least one population was severely impacted by development on Ft. Benning (U.S. Fish and Wildlife Service 2007). At least one (USFWS 1990) and perhaps more populations have been extirpated by development on private land holdings. The majority of populations in Alabama, Georgia and South Carolina have not been visited by biologists in several years and their current condition is unknown.

At one South Carolina site, cooperation among a developer, the City of North Augusta, and the SCDNR prevented the loss of hundreds of plants.

The developer incorporated into the development plan a stream side buffer that encompassed all the relict trillium. When it was determined that a required storm water retention pond would destroy some of the plants, the developer allowed SCDNR and volunteers to move the plants to other portions of the buffer. A landowner (Dreelin-Desporte), at one Georgia site, modified logging operations on two different occasions to avoid patches of relict trillium.

Two South Carolina landowners were willing to allow collection or relocation of relict trillium from development properties if the plants would be moved off-site and the effort did not delay development of their property. With stronger regulations protecting relict trillium on private lands or financial incentives to delay timber harvest and development it is likely more landowners would be willing to cooperate in relocating plants to other suitable sites.

**e. Other natural or manmade factors affecting its continued existence:** Exotic invasive plants pose threats to trillium populations through competition for space and nutrients. The recovery plan mentioned honeysuckle (*Lonicera* spp.) and kudzu (*Pueraria lobata*). Another plant that is a range-wide concern is privet (*Ligustrum* spp.) Common chickweed (*Stellaria media*) is a concern at one site in Georgia (C. Prior, pers. comm., 2006). These invasive species may be found in relict trillium habitat singly or in various combination and densities, complicating suppression efforts.

Honeysuckle can be controlled with applications of the herbicide glyphosate (Heckel and Leege 2004; Thornton 2005) and is especially useful after senescence of relict trillium stems and leaves. Chickweed (*Stellaria* spp.) grows and sets seed during the early spring when relict trillium is actively growing above ground and most susceptible to herbicide, which could make control by herbicide more difficult.

Fire, whether wildfire or prescribed burning, was recognized in the recovery plan as a threat to relict trillium, based on habitat requirements of hardwood overstory and a thick duff layer. A burn during the spring when relict trillium is actively growing and flowering could be especially harmful, eliminating reproduction and reducing transfer of nutrients to the rhizomes. Fire during other times of the year would reduce or eliminate the duff layer and could destroy trillium seeds.

One population on Fort Benning was burned in a wildfire during the spring of 2003, destroying the vegetative parts above ground. Annual monitoring has shown an almost complete recovery by the spring of 2006 indicating that relict trillium populations may recover from infrequent

fires when given enough time between fires to rebuild energy stores and for habitat to recover.

#### **D. Synthesis**

Relict trillium's known range has increased since publication of the recovery plan (Patrick 2004), but there have been reductions of habitat within the range as a result of development, quarrying, timber stand conversion, and road construction. The number of known populations has more than doubled, from 21 to 72 likely because of increased interest in the plant and increased botanical survey efforts on Federal and State lands. However, there is no indication that relict trillium is expanding in range or number of populations, rather that existing populations are being found for the first time. The genetic study conducted by Gonzales and Hamrick (2005) on populations of relict trillium indicate that populations have been scattered and isolated since ancient times.

The populations on Federal and State lands receive some level of protection from land use changes but are still susceptible to herbivores, exotic invasive plants, disease and fire management. New threats include the unidentified cutworm infesting South Carolina populations and a fungal disease. Threats from exotic invasive species have not abated, and several new species have been recognized as threats since the recovery plan was written.

There has been progress in the recovery of the species as there are now 12 protected populations, nine in Georgia, two in South Carolina, and one in Alabama. Six of the populations are also actively managed to reduce competition from invasive plants, herbivores (exclusion fencing) and fire. The Georgia total exceeds the requirements of the recovery plan (seven) while South Carolina one and Alabama need one additional protected population(s) each to meet recovery goals. The recent genetic study by Gonzales and Hamrick (2005) has shown relict trillium to have high genetic variability between populations, and it is probable Alabama populations represent a different lineage than the Georgia populations. The number and distribution of protected populations necessary for delisting should be reevaluated to determine the number and distribution required to preserve the genetic variability of the species.

### **III. RESULTS**

**A. Recommended Classification:** Endangered (no change). The primary factors negatively affecting relict trillium that justified listing have not abated. Additional threats have been described since the recovery plan was completed and unusual genetic variability between populations and between groups of populations has been documented. An increase in the number of protected populations specified in the recovery plan may be necessary to maintain genetic variability. Populations protected from land use changes suffer from the effects of exotic invasive species. There are enough populations that are owned by conservation partners to achieve recovery, however, there is no agreement in

place to protect or manage for this species and at several sites these potential conservation populations are severely impacted by the threats listed above.

- B.** When managing for relict trillium populations, unless otherwise indicated, they should be treated as genetically distinct and vulnerable to disturbance. Based on the findings of Gonzalez and Hamrick (2005), each relict trillium population is genetically distinct with little gene flow occurring between them. Gonzalez and Hamrick believe this rarity and population isolation may be an artifact of the more ancient origins, rather than the fault of more recent anthropogenic fragmentation following European colonization. A study by Thompson in 2007 suggests that white tailed deer (*Odocoileus virginianus*) herbivory rates are having negative impacts on the survival and reproduction of relict trillium. Removal of Japanese Honeysuckle (*Lonicera japonica*) resulted in significant population increases of relict trillium. Patrick (1995) advises to avoid disturbance since the plant will not tolerate heavy canopy clearing and to control for exotic species, particularly *Lonicera japonica*. A study performed by Jules (1998) saw significant decreases in recruitment by *Trillium ovatum* Pursh which suggests that trilliums can be very vulnerable to the edge effects from forest fragmentation. Managers should limit tree-clearing operations, monitor for herbivory by feral pigs and white-tailed deer, and attempt to control encroaching invasive species.

**B. New Recovery Priority Number:** 8c (no change)

Relict trillium warrants the “c” ranking indicating conflict with construction and development projects or other forms of economic activity, largely because of conflicts with federally-funded road construction projects.

**C. If a reclassification is recommended, indicate the Listing and Reclassification Priority:** Reclassification is not recommended.

#### **IV. RECOMMENDATIONS FOR FUTURE ACTIONS**

- Develop management agreements to abate threats with potential conservation partners including the State, Department of Defense, National Forest, The Nature Conservancy, and appropriate land trust.
- Acquire data necessary to determine the requirements for a self-sustaining population (e.g., minimum number of plants, habitat quality and quantity, distance of pollen and seed dispersal).
- Establish and maintain populations at a minimum of two botanical gardens.
- Work with the State of Alabama to protect at least one additional population.
- Work with the State of South Carolina to protect at least two additional populations.

- Reevaluate the number and distribution of protected populations necessary to maintain the genetic variability of populations and lineages on each side of the Chattahoochee River, and if necessary revise recovery criteria accordingly.
- Identify the cutworm that is found in South Carolina populations and determine its long-term impact on populations.
- Evaluate the impact of the fungal pathogen *Cibironia trilli* and its long-term impact on populations.
- Monitor a representative sample of populations annually for threats (e.g., urban development, timber harvest and stand conversion, fire, invasive exotic species, herbivore or insect damage, sustainability, disease).
- Conduct additional field research on the impacts of herbivory and invasive species on relict trillium.

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**U.S. FISH AND WILDLIFE SERVICE  
5-YEAR REVIEW of *Trillium reliquum***

Current Classification: Endangered  
Recommendation resulting from the 5-Year Review

- Downlist to Threatened
- Uplist to Endangered
- Delist
- No change is needed

Appropriate Listing/Reclassification Priority Number, if applicable: 8c

Review Conducted By: Donald W. Imm, PhD.

**FIELD OFFICE APPROVAL:**

Lead Field Supervisor, Fish and Wildlife Service

Approve  Date 9/30/2014

**REGIONAL OFFICE APPROVAL:**

*for*  
Lead Regional Director, Fish and Wildlife Service

Approve  Date 1-19-15

**Cooperating Regional Director, Fish and Wildlife Service**

Concur  Do Not Concur

Signature \_\_\_\_\_ Date \_\_\_\_\_

## **APPENDIX A: Summary of peer review for the 5-year review of relict trillium (*Trillium reliquum*)**

### **A. Peer Review Method:**

Each reviewer received an electronic draft of the 5-year review. Comments were provided by email and by hardcopy.

### **B. Peer Review Charge:**

The following letter/email was sent to each reviewer:

*Other than the format of the review, which has been prescribed by the FWS, we are open to your comments. You will notice a lot of personnel communication citations. Please make sure your personnel communication contributions have been accurately described. There still seems to be a lot more known about relict trillium than is represented in the scientific literature, so there is not a long list of papers cited. If an important paper was missed please inform us.*

*Tables have been included that list known populations in each state. All known populations may not be included, especially for Georgia, which was compiled from 2004 data. It is also possible that some populations have been extirpated. Any additions or deletions to the tables will be appreciated.*

*The recovery plan describes 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 must also occur within a sufficiently large area to ensure that, to the extent possible, natural processes within its habitat can continue without adversely affecting the population and that active management required to maintain suitable habitat is minimal." It further states, "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". To our knowledge that has never been done. As explained briefly on page 4 of the review, "metapopulations", "occurrences" and "populations" are all referred to as populations. Hopefully by the next review we will have the definitions and data necessary to classify each "group" of relict trillium correctly.*

*Do not hesitate to contact Stephen Parris immediately if you have a question.*

### **C. Summary of Peer Review Comments/Report**

**Al Schotz**, Botanist, Alabama Natural Heritage Program: Mr. Schotz commented that he thought the draft was good and pointed out the locations of several typographical errors.

**Brett M. Moule**, Region 3 Heritage Preserve Manager, South Carolina Department of Natural Resources: Mr. Moule provided comments regarding the number of protected populations in South Carolina and the status of efforts to protect a population on private land through a conservation easement. He also commented on the impacts cutworms are having on the

population on the Savannah River Bluffs Heritage Preserve and the number of populations that have been damaged by development and construction in recent years.

**Brant C. Slay**, Land Protection Specialist, The Nature Conservancy: Mr. Slay thought the review was excellent and offered no additions or corrections.

**Tom Patrick**, Georgia Natural Heritage Program, Georgia Department of Natural Resources: Awaiting final review by Tom Patrick.

#### **D. Response to Peer Review**

We agreed with the comments by the reviewers regarding number and location of populations, population trends, and efforts to protect populations. The comments were incorporated into the final review. There were also comments regarding typographical errors and format. The typographical errors were corrected in the final review. Comments regarding format were not incorporated if they conflicted with the standard Service format for 5-year reviews.