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Candidate Conservation Agreement

for the

**Georgia aster
(*Symphyotrichum georgianum*)**

between

**U.S. Fish and Wildlife Service
Clemson University
Georgia Department of Natural Resources
Georgia Department of Transportation
Georgia Power
Mecklenburg County Park and Recreation, North Carolina
National Park Service
North Carolina Department of Agriculture & Consumer Services– Plant Conservation
Program
U.S. Forest Service**

May 2014

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Common Name	Georgia aster
Scientific Name	<i>Symphyotrichum georgianum</i>
Current Range:	Alabama, Georgia, North Carolina and South Carolina
Listing Status and Date	Candidate (1999)
Lead Agency/Region	U.S. Fish and Wildlife Service, Region 4
Lead Field Office	Asheville Ecological Services Field Office 160 Zillicoa St. Asheville, NC 28804 828/258-3939
Lead Biologist	Mara Alexander, Asheville Ecological Services Field Office 828/258-3939 ext. 238, mara_alexander@fws.gov

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I. Purpose of the Candidate Conservation Agreement

This Candidate Conservation Agreement (CCA) for Georgia aster (*Symphyotrichum georgianum*) has been developed as a cooperative effort among state, federal, non-governmental, and private organizations to establish a formal agreement for public and private landowners to cooperate on actions that conserve, manage and improve Georgia aster populations range-wide with the goal of working to preclude the need to list the species under the Endangered Species Act (ESA). The CCA is voluntary and flexible in nature, and has been developed so different conservation and management actions can be agreed to and implemented.

Under Federal Executive Order 13352, Facilitation of Cooperative Conservation, the Departments of the Interior, Agriculture, Commerce, and Defense and the Environmental Protection Agency are to carry out their environmental and natural resource programs in a manner that facilitates cooperative conservation. This CCA is an example of such a cooperative conservation approach.

II. Objectives of the Candidate Conservation Agreement for Georgia aster

- a. Range-wide Conservation and Management: By addressing Georgia aster conservation across its range, the Parties hope to more effectively identify and conserve Georgia aster populations; develop and implement management strategies that maintain or enhance Georgia aster populations; and monitor the response of the species to conservation and management. Populations are defined using NatureServe's Habitat-based Plant Element Occurrence Delimitation Guidance (1 October 2004).
- b. Cooperation and Collaboration: By managing Georgia aster conservation actions in a proactive and collaborative manner, the Parties intend to promote existing individual Georgia aster conservation actions and efforts, and to share knowledge and information across a wide range and diverse collections of organizations. This allows for an organized approach to implement conservation actions and reporting of conservation efforts by each Party, including integrated efforts for population measurement and monitoring, habitat management activities, research, and providing public information on conservation achieved through this collaborative effort.

III. Parties and Cooperators to the CCA

A. Parties to the Agreement

- Clemson University
- Georgia Department of Natural Resources (GA DNR)
- Georgia Department of Transportation (GDOT)
- Georgia Power
- Mecklenburg County Park and Recreation, North Carolina
- National Park Service (NPS)
 - Chattahoochee River National Recreation Area
 - Kings Mountain National Military Park
- North Carolina Department of Agriculture & Consumer Services– Plant Conservation Program
- U.S. Fish and Wildlife Service (USFWS)
 - Cahaba River National Wildlife Refuge
 - Ecological Services, Southeast Region
- U.S. Forest Service (USFS)
 - Chattahoochee - Oconee National Forests
 - Francis Marion and Sumter National Forest
 - Uwharrie National Forest
 - Talladega National Forest

The Parties share a desire to conserve Georgia aster populations and habitat in order to prevent regulatory constraints and carry out their missions to the best of their ability. Additional Parties are welcome to sign on at any time. Upon signing this CCA by the Parties, the management actions outlined in this document will be implemented where appropriate and as funding allows. Reporting of conservation actions implemented under this CCA is described in Section XIII of the CCA.

B. Cooperators to the Agreement

- Alabama, Georgia, North Carolina and South Carolina Natural Heritage Programs
- Atlanta Botanical Garden
- North Carolina Botanical Garden
- State Botanical Garden of Georgia
- The Citadel
- The Nature Conservancy
- Army Corps of Engineers

IV. Authority

A. Parties to the Agreement

The Parties enter into the CCA under authority provided by federal and state law. Nothing in this CCA is intended to limit the authority of the USFWS to fulfill its responsibilities under federal laws. Nothing in this CCA is to imply that any Party is in any way abrogating or ceding any responsibility or authority inherent in its sovereign ownership of, jurisdiction over, and control of its property interests or wildlife. All activities undertaken pursuant to the CCA must be in compliance with all applicable state and federal laws and regulations.

Sections 2, 7, and 10 of the Endangered Species Act of 1973, as amended, 16 U.S.C. § 1531 et seq. (ESA) authorize the Service to enter into this CCA. Section 2 of the ESA states that encouraging interested parties, through Federal financial assistance and a system of incentives, to develop and maintain conservation programs is essential to safeguarding the Nation's heritage in fish, wildlife, and plants. Section 7 of the ESA requires the Service to review the programs it administers and utilize those programs to further the purposes of the ESA. By entering into the CCA, the Service is utilizing the Candidate Conservation Programs to further the conservation of the Nation's fish and wildlife.

B. Non-governmental Parties

The inclusion of non-governmental Parties to the CCA is intended to provide for voluntary conservation efforts for rare species with respect to private and state lands outside of federal land management areas, recognizing the limited applicability of the ESA's provisions on non-federal lands and lands not subject to federal permit action. Inclusion of non-governmental cooperating parties is not intended to expand the jurisdictional areas or actions subject to the ESA and non-governmental cooperating parties are afforded the same protections and limitations in the ESA.

V. CCA Management and Administration

In order to meet the objectives of this CCA, the Parties will cooperatively manage, administer, and annually review this CCA. The responsibility of the Parties is to coordinate the implementation and administration of the CCA without superseding the jurisdictional authorities of any Party. The Parties will cooperate to develop and make recommendations for the conservation and research needs of Georgia aster and identify new threats in its range. The U.S. Fish and Wildlife Service's Ecological Services Field Office in Asheville, North Carolina will initiate and coordinate annual review by the CCA Parties, in accordance with Section XIII of the CCA related to reporting.

VI. Conservation Efforts

Many public and private landowners have been working to manage Georgia aster, and improvements are continually being made in population size and vigor. A few examples of work to conserve the Georgia aster by Parties to the Agreement and other landowners are highlighted below.

Georgia Department of Natural Resources

Oaky Woods Wildlife Management Area in Georgia has used prescribed fires to help manage for this species. Georgia aster (one patch with five flowering-stems) was discovered on the largest prairie remnant in October 2006. Regular winter and early growing season burns every 1 to 3 years on the Georgia aster prairie since 2007 greatly enhanced the prairie. In 2012 the small patch had increased to more than 80 flowering stems in a 30 by 10 m area and several new patches have now been found on other parts of the prairie habitat (Tom Patrick, GA DNR, pers. comm. 2013).

National Park Service

The Chattahoochee River National Recreation Area in Georgia annually monitors the populations that grow in the park. In coordination with GDOT, plants were rescued from a road-widening site within the park in 2012 and planted near a parking lot which is maintained via weed-trimming in winter months. This site now has 256 stems showing good viability (Read and Pierson 2012).

State Departments of Transportation

In Georgia, North Carolina and South Carolina, populations have been relocated in advance of road improvement activities that would have destroyed or modified Georgia aster habitat.

U.S. Fish and Wildlife Service and Cooperators

In order to answer questions that would help determine if Georgia aster is warranted for listing, in September 2010, the USFS and USFWS allocated funds toward a rangewide assessment of seed viability and population genetic structure in Georgia aster. This project involved collaborators from the Atlanta Botanical Garden, the North Carolina Botanical Garden, the State Botanical Garden of Georgia, and The Citadel. The projects were completed in early 2013. They provided information on the levels of genetic diversity within populations while also examining correlations between population size and genetic diversity and seed production. Research results are discussed in the Habitat/Life History section below. This work helped with the formation of the CCA conservation strategy.

U.S. Forest Service

The USFS has been thinning woody vegetation, using prescribed burns and non-native invasive species treatments to manage for Georgia aster on national forest land. This management work has aided many populations on the Chattahoochee National Forest in Georgia. As of 2013, about 5000 stems of Georgia aster from 9 populations grow on the Chattahoochee National Forest. The Chattahoochee National Forest is also working with partners on propagation and out-planting (Joanne Baggs, USFS, pers. comm. 2013). The Talladega National Forest contains Alabama's largest population (~4000 individuals). In 2008, the Talladega National Forest thinned longleaf pine stands to savannah conditions specifically to aid the Georgia aster population. The Talladega National Forest is partnering with Auburn University to grow and plant ~2000 Georgia aster seedlings (Gary Shurette, USFS, pers. comm. 2013). The Uwharrie National Forest in North Carolina reduced the basal area of an oak-hickory forest adjacent to a Georgia aster population from 100 ft² to less than 40 ft² in 2002. This area was burned in 2003 with the fireline constructed next to the original Georgia aster population of 60 stems which grew along a fenceline. This population expanded into the fireline by 2004 and stem counts in 2010 and 2011 indicated a 25-fold increase from 1998 counts (Gary Kauffman, USFS, pers. comm. 2013). Over 7000 individuals of Georgia aster from twelve populations grow on the Sumter National Forest in South Carolina. Sumter National Forest is working with propagation, out-planting and using prescribed-fire and woody vegetation thinning to increase Georgia aster population size where it grows on the forest (Robin Mackie, USFS, pers. comm. 2013).

VII. Species Description, Taxonomy, Life History and Range

A. Species Description

Georgia aster has large heads, 5 centimeters (cm) (2 inches (in)) across (containing numerous flowers), with dark purple rays up to 2.4 cm (0.9 in) long, and thick, lanceolate to oblanceolate, scabrous, clasping leaves. Flowering occurs from early October to mid-November. Disk flowers are white fading to a light or dull lavender, tan or white as they mature, resulting in a difference between colors of early and mature disk corollas. The ribbed achenes are up to 4 millimeters (0.1 in) long, with evenly distributed spreading trichomes. Georgia aster can be distinguished from the similar *S. patens* by its dark purple rays (compared to the light lavender rays of *S. patens*), and white to lavender disk flowers (compared to the yellow disk flowers of *S. patens*).

Various species of butterflies and bumblebees have been observed pollinating the flowers, but these have not yet been identified to species (Matthews 1993, p. 21).

B. Taxonomy

Alexander initially described the species as *Aster georgianus* based on a specimen collected by Cuthbert in 1898 from Augusta (Richmond County), Georgia (Small 1933, p. 1381). The distribution was listed as the coastal plain and piedmont of Georgia and South Carolina. When Cronquist (1980) prepared the treatment of the Asteraceae for the Southeastern Flora, he included *A. georgianus* as a variety of *A. patens*. Jones (1983), in a Ph.D. dissertation on the Systematics of *Aster* Section *Patentes* (Vanderbilt University, TN), provided morphological, cytological, geographic distributional and ecological evidence that supported consideration of this taxon as a distinct species.

The genus *Aster* L. (*sensu lato*) contains some 250-300 species that occur in the northern Hemisphere of Eurasia and North America, with a few species occurring in South America (Nesom 1994). Recent evidence, derived from morphological and molecular characters as well as chromosome counts, supports earlier contentions that North American species are distinct from Eurasian and South American species, and that a major revision of the genus is needed (e.g., Nesom 1994; Noyes and Rieseberg, 1999; Brouillet et al. 2001; Semple et al. 1996). According to these findings, the currently accepted nomenclature for this taxon is *Symphotrichum georgianum* (Alexander) Nesom.

C. Habitat and Life History

Georgia aster occupies woodlands or piedmont prairies dominated by native plant species. Soils vary from sand to heavy clay, with pH ranging from 4.4 to 6.8 at the sites sampled for a 1993 study on the species (Matthews 1993, p.20). The primary controlling factor appears to be the availability of light. The species is a good competitor with other early successional species, but tends to decline when shaded by woody species. Populations can persist for an undetermined length of time in the

shade, but these rarely flower (Matthews 1993, p.20) and reproduce only by rhizomes.

A genetic study completed in 2013 supports the hypothesis that Georgia aster is a perennial outcrossing species due to the majority of its genetic variation being partitioned within populations (87.5 %) with less (12.3 %) partitioned among populations within states. The genetic relationships among populations roughly reflected geographic proximity, with populations grouping into three groups: Alabama, Georgia, and the Carolinas. This genetic survey suggests no difference in genetic variation or seed fitness between large and small populations of Georgia aster (Gustafson 2013, p. 4-5). A seed viability analysis study, done by the Atlanta Botanical Garden, showed that across the range of the species, the percent filled seed ranged from 77 to 99 % with a trend for smaller populations to have higher percentages of filled seed. The range in germination percentage ranged from 20 to 90 % with seeds from North Carolina populations having significantly lower germination percentages than seeds from other states (Cruse-Sanders 2013, p. 1).

D. Historical Range and Distribution

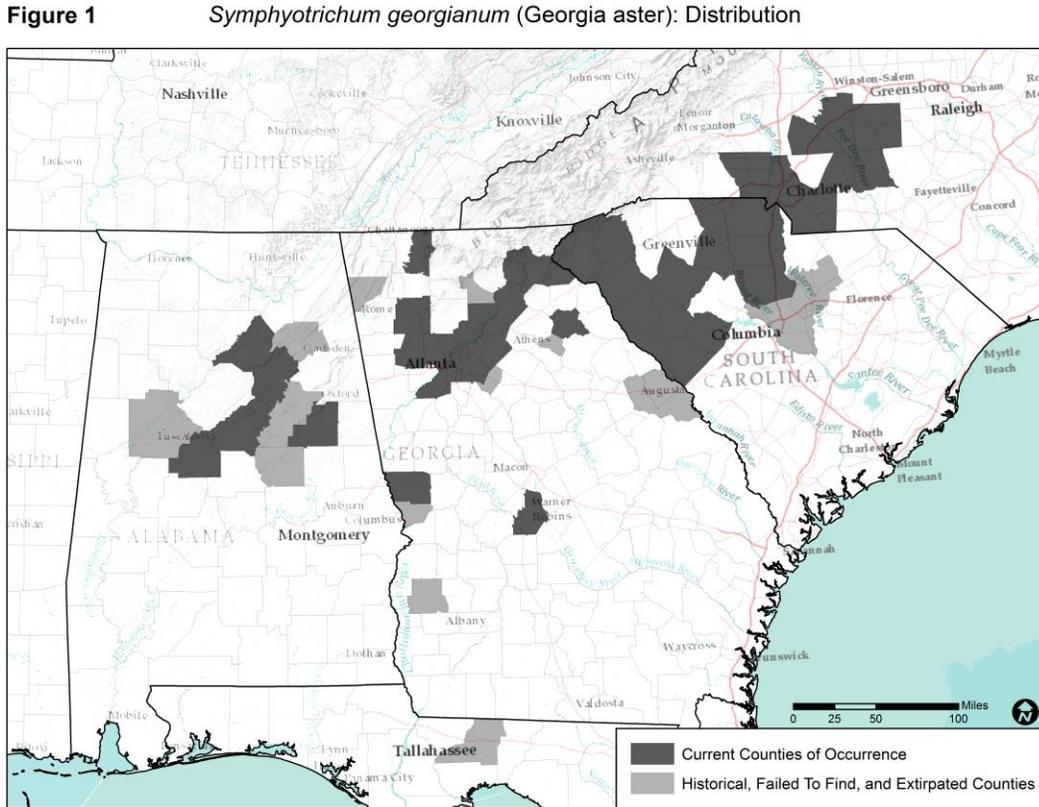
Georgia aster is a relict species of post oak savanna/prairie communities that existed across much of the southeastern United States prior to widespread fire suppression and extirpation of large native grazing animals (e.g., bison). The species appears to have been extirpated from Florida (Leon County), one of the five states in which it originally occurred. Inspection of state Natural Heritage Program (NHP) databases and additional location data on file with the USFWS indicates a total of 146 populations of the species (using a 2-km buffer around each centroid); of these 28 (19 %) are either extirpated or historical (not observed in more than 20 years), or have not been found despite survey attempts.

In most cases the exact cause of extirpation of populations was not documented, but herbicides, highway construction, fire suppression, and residential and industrial development have all altered the landscape in which Georgia aster historically occurred.

E. Current Range and Distribution

Georgia aster is presumed extant in 5 counties in Alabama, 15 counties in Georgia, 9 counties in North Carolina, and 14 counties in South Carolina (Figure 1). The species has been documented at 283 site-specific locations that (due to the proximity of many sites) aggregate into 146 probable populations of the species. Of these 146 populations, 118 are presumed extant. In many cases, the locations reported to contain the species have not been observed in 10 or more years, therefore additional survey effort is needed to accurately characterize the current distribution of the species.

Figure 1. The current and historical county-scale distribution of Georgia aster.



VIII. Existing Populations and Lands in Conservation Status

As of 2013, 55 of the 118 known extant populations are afforded some level of protection in that they occur on lands owned and managed by federal, state, or local (county) governments or private conservation organizations (Table 1).

Table 1. Georgia aster populations in conservation ownership. (There are some populations that grow in more than one property).

Conservation organization	Site name	# of populations
Alabama Department of Conservation and Natural Resources	Cahaba River Wildlife Management Area	1
Clemson University	Clemson Experimental Forest	3
Georgia Department of Natural Resources	Oaky Woods Wildlife Management Area	1
Georgia Department of Natural Resources	Lower Broad River Wildlife Management Area	1
Georgia Department of Natural Resources	Pickett's Mill State Historic Site	1
Georgia Department of Natural Resources	Red Top Mountain State Park	1
Georgia Department of Natural Resources	Allatoona Wildlife Management Area	1
Georgia Department of Natural Resources	Pine Log Wildlife Management Area	1
Georgia Department of Natural Resources	Watson Mill Bridge State Park	1
Georgia Department of Natural Resources	Wilson Shoals Wildlife Management Area	2
Georgia Department of Natural Resources	Paulding Forest Wildlife Management Area	2
Georgia Department of Natural Resources	Coosawattee Wildlife Management Area	1
Mecklenburg County, North Carolina	McDowell Nature Preserve	1
Mecklenburg County, North Carolina	Reedy Creek Nature Preserve	1
Mecklenburg County, North Carolina	Latta Plantation Nature Preserve	1
Mecklenburg County, North Carolina	Shuffletown Prairie Nature Preserve	1
Mecklenburg County, North Carolina	Gateway Nature Preserve	1
National Park Service	Chattahoochee River National Recreation Area	6
National Park Service	Kings Mountain National Military Park	1
North Carolina Department of Agriculture, Plant Conservation Program	Mineral Springs Barrens Plant Conservation Preserve	1
North Carolina Department of Transportation	Mitigation land	1
South Carolina State Parks	Kings Mountain State Park	1
The Nature Conservancy		1
U.S. Army Corps of Engineers	Lake Sidney Lanier	1
U.S. Fish and Wildlife Service	Cahaba River National Wildlife Refuge	2
U.S. Forest Service	Talladega National Forest	1
U.S. Forest Service	Sumter National Forest	13
U.S. Forest Service	Chattahoochee National Forest	9
U.S. Forest Service	Uwharrie National Forest	6

IX. Primary Threats Influencing the Survival of the Species

A description of each of these threats is presented below; each is classified according to the five listing/delisting factors identified in section 4 of the Endangered Species Act (“Act”; 16 USC 1531 *et seq.*).

A. The present or threatened destruction, modification, or curtailment of its habitat or range (Factor A)

The destruction and loss of habitat due to development can detrimentally affect small populations of many rare or locally endemic species, including Georgia aster. Habitat loss due to development has been considered to be a threat to the species in the states where it currently is found, and historically throughout its range (Misty (Franklin) Buchanan, North Carolina NHP, pers. comm. 2007 and Al Schotz, Alabama NHP, pers. comm. 2007). Disturbance (fire, native grazers, etc.) is a part of this species’ habitat requirements. The historic sources of this disturbance have been virtually eliminated from Georgia aster’s range, except where road, railroad and rights-of-way (ROW) maintenance are mimicking the missing natural disturbances. The habitat of some existing populations continues to be subject to destruction, modification, or curtailment due to planned residential subdivision development, highway expansion/improvement projects, and by woody succession due to fire suppression.

B. Overutilization for commercial, recreational, scientific, or educational purposes (Factor B)

This species is not currently known to be a significant component of the commercial trade and the USFWS is not aware of any utilization of the Georgia aster for recreational, scientific, or educational purposes. Consequently, overutilization is not known to be a problem for this species.

C. Disease or predation (Factor C)

Within all sites visited in 2010 and 2011 for seed collection in North Carolina, researchers of the North Carolina Botanical Garden, USFS and USFWS found larvae feeding on seeds inside the heads. This was also apparent in other Asteraceae blooming in the fall during this collection period. Percent of infested heads varied by site and ranged from 10% to 40% of the Georgia aster seed heads present. Seeds in infested heads seemed to have low to no viability.

Within one site visited in 2011 for seed collection in North Carolina, that was away from the road side, there was evidence of deer browse and reduced seed set in 2011 (Michael Kunz, North Carolina Botanical Garden, pers.comm. 2012). North Carolina Department of Transportation found that much of one population they helped to

conserve was heavily impacted by deer browse, prompting them to place deer fencing around transplants in a conservation area (Herman and Frazer 2012, p. 3). Many of Georgia's populations are also impacted by deer browse (Mincy Moffet and Tom Patrick, Georgia Department of Natural Resources, pers. comm., 2013).

D. The inadequacy of existing regulatory mechanisms (Factor D)

Under this factor, we examine whether existing regulatory mechanisms are inadequate to address or alleviate the threats to the species discussed under the other factors. Section 4(b)(1)(A) of the Act requires the Service to take into account "those efforts, if any, being made by any state or foreign nation, to protect such species..." In relation to Factor D under the Act, we interpret this language to require the Service to consider relevant Federal, State and tribal laws, plans, regulations and other such mechanisms that may minimize any of the threats we describe in threat analyses under the other four factors, or otherwise enhance conservation of the species. We give strongest weight to statutes and their implementing regulations and to management direction that stems from those laws and regulations. An example would be State governmental actions enforced under a State statute or constitution, or Federal action under statute. Having evaluated the significance of the threat as mitigated by any such conservation efforts, we analyze under Factor D the extent to which regulatory mechanisms are inadequate to address the specific threats to the species. Regulatory mechanisms, if they exist, may reduce or eliminate the impacts from one or more identified threats.

1. State Regulations

The North Carolina Plant Conservation and Protection Act (NC State Code Article 19B, § 106-202.12) provides limited protection from unauthorized collection and trade of plants listed under that statute. However, this statute does not protect the species or its habitat from destruction in conjunction with development projects or otherwise legal activities. Plant species are afforded some protection in South Carolina, where they are protected from disturbance where they occur on those properties owned by the state and specifically managed as South Carolina Heritage Preserves (SC State Code of Regulations Part 123 § 200-204). Portions of two South Carolina populations occur on state park land, and are afforded some protection by this state statute. Collection of Georgia aster on public lands without a permit is prohibited in Georgia under the Georgia Wildflower Preservation Act of 1973. No such provisions are afforded to plants found on privately-owned lands in the State. The species does not receive any specific legal protections from State laws or regulations in Alabama.

2. Federal Regulations

Thirty-eight extant populations of Georgia aster occur on federal lands (USFS National Forest lands, including the Chattahoochee-Oconee, Sumter, Talladega, and Uwharrie National Forests; NPS lands, including the Chattahoochee River National Recreation Area and Kings Mountain National Military Park; the Cahaba River National Wildlife Refuge; and land owned by the U.S. Army Corps of Engineers).

The USFS has to maintain viability of this plant on each planning unit where it occurs because Georgia aster is a USFS region 8 sensitive species. The USFS considers the effects of their actions on the viability of sensitive species through the National Environmental Policy Act (NEPA) process. As defined by USFS policy, actions should not result in loss of species viability or create significant trends toward the need for Federal listing.

National Park Service Policies (NPS 2006) state that “The National Park Service will inventory, monitor, and manage state and locally listed species in a manner similar to its treatment of federally listed species to the greatest extent possible. In addition, the NPS will inventory other native species that are of special management concern to parks (such as rare, declining, sensitive, or unique species and their habitats) and will manage them to maintain their natural distribution and abundance.”

E. Other natural or manmade factors affecting its continued existence (Factor E)

Due to the elimination of historic sources of disturbance that helped maintain suitable habitat condition for the species, most of the known remaining populations of Georgia aster are adjacent to roads, railroads, utility ROW and other openings where land management mimics natural disturbance regimes. However, at these locations the Georgia aster also is inherently vulnerable to accidental destruction from herbicide application, road shoulder grading, and other maintenance activities. More utility companies and railroads are shifting to herbicide spraying instead of mowing for longer-lasting control of vegetation growth. Repeated mowing of Georgia aster populations during the height of the growing season can reduce population vigor, and may eventually kill plants, but these effects take longer to manifest than direct application of herbicides during the growing season.

Several sites are impacted by the encroachment of invasive exotic plants. At this time, however, we do not know how many populations of the Georgia aster are impacted or the nature of the impacts of invasive plants.

The Chattahoochee River National Recreation Area biologists have seen possible evidence of hybridization with *Symphotrichum patens* in multiple populations (Allyson Read, NPS, per. comm. 2013). No other reports of hybridization with in Georgia aster’s range have been reported.

F. Summary of Threats

The current and threatened destruction, modification, and curtailment of the habitat and range of the species (Factor A) are a concern for the species in the states where it currently is found. Residential subdivision development, highway expansion/improvement projects, and woody succession due to fire suppression are all threats to habitat, though these threats are abated in a large percentage (>45%) of known populations due to management practices currently being undertaken by USFS, NPS, and multiple state agencies. The inadequacy of regulatory mechanisms to protect the habitat of the species and to protect individuals or populations from being destroyed is a concern (Factor D), but the Federal regulations upheld by the USFS helps to protect close to 30 populations. As described in Factor E, management (untimely mowing and off-target herbicide applications) of roadside and utility ROW, where the majority of the known remaining populations occur can directly kill the plants.

X. Range-wide Conservation, Management, Reporting Actions

To accomplish the objectives of this agreement, all Parties to the CCA agree to undertake the conservation measures described herein. Actions taken under this agreement are cooperative and voluntary and may help with the understanding of the habitat, life history requirements, and improve the overall status of this species.

The U.S. Fish and Wildlife Service will support the implementation of the CCA by helping to develop a uniform monitoring and reporting format for the Parties, as described in Section XIII of the CCA.

A. Information Management

Reports on management and monitoring from all Parties in the form of detailed elemental occurrence reports will be submitted annually to the corresponding state heritage program. The USFWS Asheville Ecological Services Field Office will request annual elemental occurrence reports from state heritage programs, and distribute information to the Parties during annual review of CCA implementation efforts.

B. Management Practices

1. Site Management to be Implemented by all Parties

Primary management work will include thinning trees to benefit patches of Georgia aster and other native grasses and forbs by reducing the density of trees to 30-60 ft²/ac BA. This condition would result in a desirable amount of sunlight reaching the forest floor. Georgia aster blooms best in full sun. Low canopy

basal areas (30-60 ft.²) allow herbaceous understories to thrive, while minimizing drought and competition and are consistent with a woodland or savanna community structure. Thinning of trees can be performed by prescribed burns on a 2-5 year rotation depending on the need to arrest species competition (taking into account private land and urban interface issues, and other resource values), or by manual removal, cutting, or the application of herbicides. It may take multiple herbicide applications to control hardwood sprouts. Manual removal, cutting, or herbicide use would be conducted on an annual basis, or as needed, and in conjunction with prescribed burning where possible. Patches of Georgia aster should be identified and marked and management efforts (chiefly herbicide efforts) should be used with extreme care in these areas.

Heavy equipment should be kept out of rare plant areas between May 15 and November 15, or during wet periods when soil compaction may occur. Employees working near known Georgia aster populations should be taught to recognize the rare plants in an effort to avoid damaging them.

2. Guidelines for Right-of-way Management

Within the first three years the CCA is implemented, high-priority populations found in ROW will be identified and the following management guidelines will be put in place for those high-priority populations. Easements or ROW within Federal lands and authority will be considered high-priority and will require cooperative management among landholders. The decision to label additional populations as high-priority will be coordinated among Parties and will take into account multiple factors including, but not limited to, the density of Georgia aster stems and the location of the population.

All Parties who manage Georgia aster in road ROW agree to the following management guidelines:

- No mowing May 15 -November 15. The beginning of May is when non-native invasive plants have the maximum amount of biomass above ground and the least amount of below ground biomass. Mowing should occur as close to that time as possible to keep non-native invasive plants suppressed. Georgia aster will be starting to grow by then, but should be short enough that a mower would not significantly impact the plants.
- No broadcast spraying of herbicides, no fertilizers. Spot herbicide treatment can be used as needed with protection of Georgia aster plants to prohibit off-target impacts.
- Mowing from November 16 - May 14 is allowed and, in most cases, should be done at least every other year.

- Mowing should be avoided when the soil is wet, as compaction and rutting will occur.
- The standard mowing height is usually four inches; ideally, the mower should be set at a level to avoid scalping the ground and damaging rare plants.
- Clippings from winter mowing should be left on site so any Georgia aster seeds produced will have the opportunity to germinate within the population. Exceptions should be made if only non-native invasive plants are reproducing.
- Prior to entering the site, operators of mowers and equipment should strive to clean equipment to remove any accumulated vegetative debris that contains non-native invasive plant seeds.
- The management guidelines listed above will be completed where feasible and when not in conflict with road projects or drivers safety.

All Parties who manage Georgia aster in powerline ROW agree to the following management guidelines:

- No mowing May 15 -November 15. The beginning of May is when non-native invasive plants have the maximum amount of biomass above ground and the least amount of below ground biomass. Mowing should occur as close to that time as possible to keep non-native invasive plants suppressed. Georgia aster will be starting to grow by then, but should be short enough that a mower would not significantly impact the plants.
- No broadcast spraying of herbicides, no fertilizers. Spot herbicide treatment can be used as needed with protection of Georgia aster plants to prohibit off-target impacts.
- Mowing from November 16 - May 14 is allowed. The frequency of mowing will follow pre-existing schedules.
- Mowing should not be conducted when the soil is wet, as compaction and rutting will occur.
- The mower should be set at a level to avoid scalping the ground and damaging rare plants.

- Clippings from winter mowing should be left on site so any Georgia aster seeds produced will have the opportunity to germinate within the population. Exceptions should be made if only non-native invasive plants are reproducing.
- Prior to entering the site, operators of mowers and equipment should strive to clean equipment to remove any accumulated vegetative debris that contains non-native invasive plant seeds.

3. Signs to Indicate Presence of Georgia Aster Populations for Equipment Operators

Georgia aster high-priority occurrences in ROW should be marked with signs stating that there is no mowing or broadcast spraying of herbicides between May 15 – November 15 of each year. The signs should be positioned at both ends of high-priority areas, situated so mowers and equipment operators will see the signs as they approach from all sides of an area. The signs need to be able to be interpreted by non-English readers – possibly with universal symbols. These signs should be large enough to be easily noticed and if lower signs are allowed, the signs should be placed down at shoulder level. Where Georgia aster occurs along a significant stretch of ROW, it is suggested that double sided signs be placed periodically so that if a sign at one end of a high-priority area disappears, another sign will be encountered prior to the entire area being sprayed or mowed inappropriately. Maintaining the signs and sign visibility is critical in order to protect these high-priority areas. Damaged or missing signs should be replaced as soon as possible, especially during the growing season.

4. Non-native Invasive Species Control

Competition with non-native invasive species either occurs, or has the potential to occur, at all Georgia aster sites in the region. Common threats include autumn olive (*Elaeagnus umbellata*), Japanese honeysuckle (*Lonicera japonica*), bicolor lespedeza (*Lespedeza bicolor*), sericea (*Lespedeza cuneata*), kudzu (*Pueraria lobata*), Johnson grass (*Sorghum halepense*) and Bahia grass (*Paspalum notatum*). This situation is exacerbated by the disturbed environments, especially along roadside and power rights-of-way, that currently support the majority of Georgia aster populations. Because of the open conditions and continuing disturbances characteristic of these areas, they are frequently among the first areas invaded by non-native, invasive plants. Management of non-native invasive plants will occur when needed at each of the Georgia aster populations. As described in the ROW management guidelines, no broadcast spraying of herbicides should be used. Spot herbicide treatment can be used as needed with protection of Georgia aster plants to prohibit off-target impacts.

5. Propagation/Enhancement of Georgia Aster Populations

Georgia aster seed rapidly loses viability over one to two years when stored at room temperature. The ability to increase seed longevity through cryopreservation storage may be a critical step in the conservation of this species. (Lynch et al. 2013). However, cryopreservation may not be needed if the ripening (and dormancy development) process is shortened by collecting the seed as soon as the color fades from the petals and immediately sown in a warm, moist location lightly covered with soil, the seeds can germinate in a few short weeks (Merck 2012). Germination percentages, depending on the seed source, can reach 90% (Cruse-Sanders 2013, Merck 2012). If grown in a greenhouse, one gallon-sized blooming plants can be reached in one year (Merck 2012).

Greenhouse-grown Georgia aster plants can be used to enhance managed populations. If Parties pursue population enhancement, Parties will ensure that seeds and plants used for plantings originate from local ecotypes. Quantitative data for all enhancement projects will be recorded and copies of all data will be sent electronically to the USFWS Asheville Ecological Services Field Office, and will be shared annually with all Parties upon review of CCA implementation.

C. Adaptive Management

Parties, who have the capability to, will use adaptive management techniques when working to restore and maintain Georgia aster populations. Adaptive management is a structured, iterative process of robust decision making in the face of uncertainty, with an aim to reducing uncertainty over time via monitoring. An adaptive approach involves exploring alternative ways to meet management objectives, predicting the outcomes of alternatives based on current knowledge, implementing one of more of these alternatives, monitoring to learn about the impacts of management actions, and then using the results to update knowledge and adjust management actions. Adaptive management focuses on learning and adapting, through partnerships of managers, scientists, and other stakeholders who learn together how to create and maintain sustainable ecosystems. Adaptive management will consider authorized uses of property (e.g. utility, rail, road corridor) and attempt to harmonize those uses with the voluntary objectives of this CCA within the operational and safety limitations of those activities. Information learned from adaptive management will be shared with the Parties at annual review of CCA implementation.

XI. Monitoring and Data Collection

A. Phase I – Data Collection and Biotics Updates for Existing Populations, and Surveys for New EOs/Populations (Years 1-3).

The first three years of the CCA will focus on updating and expanding both the knowledge base and database of known information regarding the species' populations. The goal of the surveys will be to improve our understanding of the current range, distribution, and population status of the species. Parties will conduct informal surveys of all known element occurrences (EOs) of the species, believed both extant and extirpated, on the lands under their ownership or management at least once during the Phase I period. Searches will also be made in likely habitat on same lands for additional, undiscovered, EOs. Standard information necessary to update state Natural Heritage Program Databases (i.e., Biotics) and NatureServe will be collected and provided to the appropriate state Natural Heritage Programs for database input and updating. A description of threats present and the severity of those threats will accompany each EO survey.

Given the number of recently-discovered populations of Georgia aster, the Parties agree that reporting all known EOs during the first three years of implementation of the CCA will produce new records that will substantially increase the number of populations and stem counts for the species. This action should improve the understanding of the current status of and threats to the species and inform Phase II (Long-term Monitoring Plots) of this CCA.

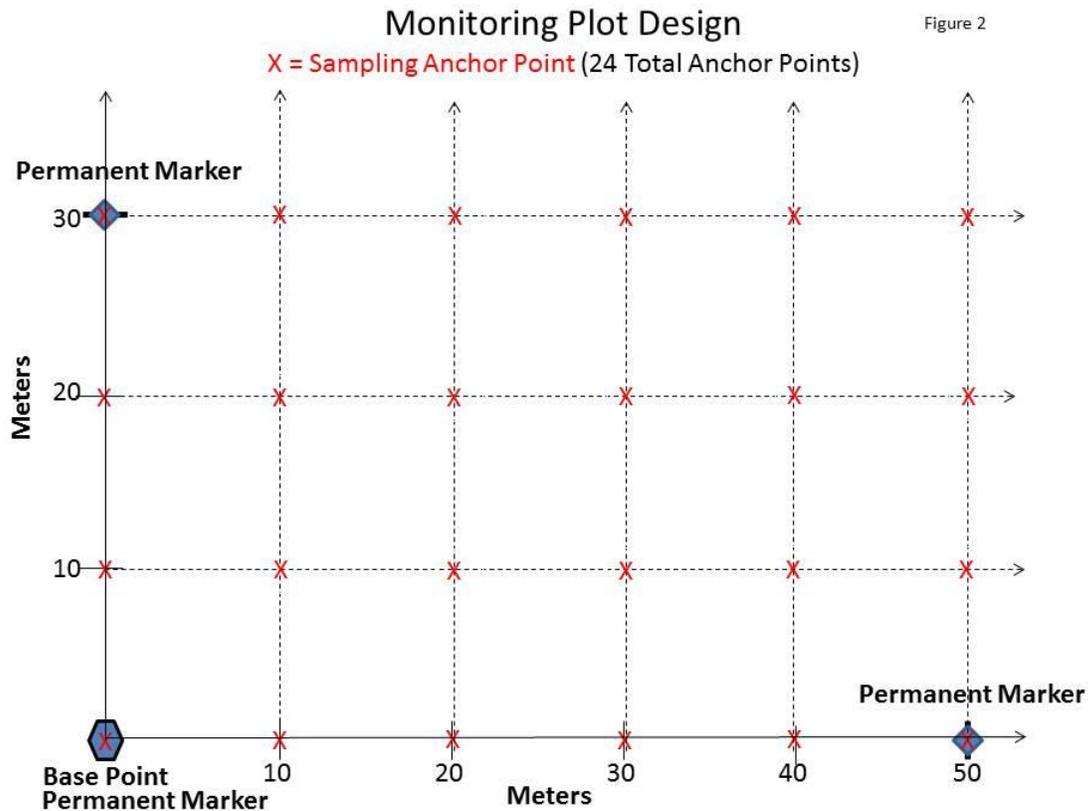
If any of the Parties completes the updating and surveying tasks on their lands prior to the end of Year 3, they should proceed to Phase II monitoring.

During the annual reviews convened by the USFWS to evaluate implementation of the CCA and benefits to the Georgia aster, the Parties will review and evaluate the resulting surveys and updates from Phase I.

B. Phase II – Selection and Installation of Long-term Monitoring Plots, and subsequent Monitoring of Plots (Years 4+).

Phase II will quantitatively monitor extant occurrences (including updates from Phase I). The goal of the monitoring will be to estimate the population trend of the species across its range. The monitoring procedure will be a relatively straightforward and expeditious plot count, designed to be implemented by a single general technician in a half day, and focused on documenting differences in flowering stem counts. Flowering stems were selected as the focal attribute to provide ease of measurement (high visibility), and increased taxonomic accuracy (i.e., avoid misidentification with *Symphotrichum patens*).

Figure 2. Long-term monitoring plot design to be implemented at target populations.



The basic plot design for long-term monitoring (Figure 2) involves a 50 m x 30 m macro-plot, organized on a 10 m x 10 m grid, yielding 24 sampling or anchor points. Quadrat design (size and number of sampling points) may be amended for smaller or more linearly disposed EOs. Parties will select a minimum of six (6) target populations for long-term monitoring. Populations will be defined using NatureServe’s Habitat-based Plant Element Occurrence Delimitation Guidance (1 October 2004). Parties with fewer than 6 populations, but with 6 or more EOs (multi-EO populations) will select 6 EOs for long-term monitoring. The 6 EOs selected will include at least one EO from every population. Parties with fewer than 6 EOs, but with 6 or more mapped source points (multi-source point EO’s) will select 6 source-points for long-term monitoring. The 6 source-points selected will include at least one source-point from every EO.

Target populations (or target EO's/source points) will be stratified by size into one of three size categories based on numbers of flowering stems (Table 2). EO's will be further stratified by threat into one of two threat categories (imminent/severe or mostly not present/minor). Selection of the 6 target populations for long-term monitoring will be selected randomly from the stratified groups. An attempt will be made to select at least one plot for long-term monitoring from each of the stratified combinations shown in the table below. Sampling quadrats will be subjectively placed on the landscape in such a way as to either capture all of the individuals of a populations (if a small population), or to capture a representative portion of the populations (if a larger population). EO's will be monitored once every three (3) years.

Table 2. Visual representation of how target populations should be stratified by size and threat.

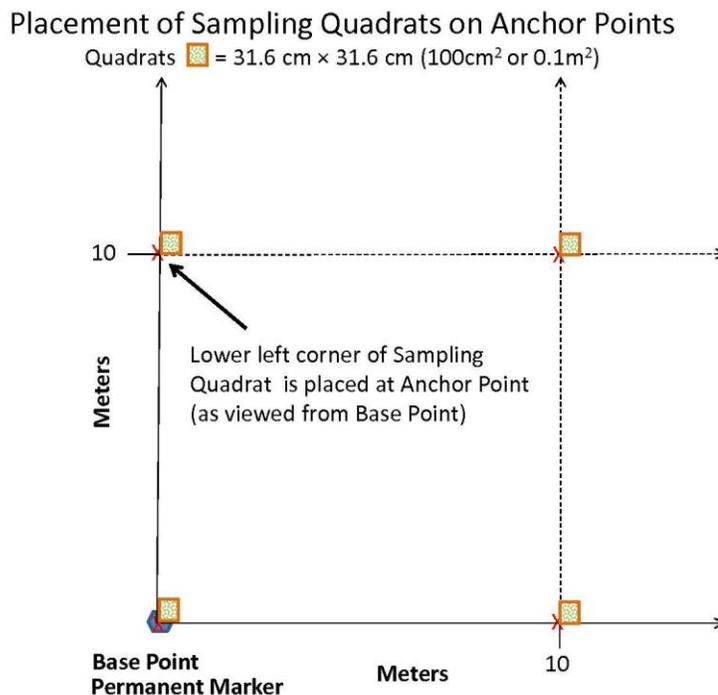
	Population Size (#'s of Flowering Stems)		
Threat Level	Small (≤ 100)	Medium (101-1,000)	Large ($> 1,000$)
Not Present/Minor			
Imminent/Severe			

The target populations selected by each CCA Party will first undergo a general reconnaissance to determine its extent. A base point will be chosen subjectively near the center of the population and permanently staked with rebar. To create a 10 x 10 meter sampling grid, two tapes will be run at a 90 degree angle from the base point, the long axis running into the most extensive portion of the population. One tape will be staked at 30 meters, the other at 50 meters, and both tapes marked by temporary flags every 10 meters. A third tape will be run parallel to the 30 meter tape, beginning at the 50 meter mark of the 50 meter tape, staked at both ends, and flagged every 10 meters. Using the flags on the two 30 meter tapes as guides, the investigator will complete the sampling grip, flagging every 10 x 10 meter point, for a total of 24 sampling points (Figure 2).

Parties to the CCA, or an investigator acting on their behalf, will record at each sampling point depicted by the sampling protocol in Figure 3, the presence or absence of flowering stems of Georgia aster in 31.6 x 31.6 cm (100 cm² or 0.1 m²) plots (quadrats) cornered to the flags. The dimensions for this quadrat are consistent with Whittaker and modified-Whittaker based sampling designs utilizing a "power of 10" scaling for nested quadrats. Quadrats of this size can be found in various sampling schemes in use by federal and state agencies T(e.g., Fire-effects Monitoring, Habitat Restoration Monitoring, Carolina Vegetation Survey [Pulse]). It is suggested that parties construct a standardized quadrat, cut to proper dimensions, prior to field work. This quadrat can be used for repeated applications and will reduce both the effort and error of sampling.

To be counted as present, a flowering stem must be rooted within the quadrat, and be of a sufficient developmental state as to be identifiable as Georgia aster (i.e. not *S. patens* or another member of the Asteraceae family). Flowering stems were chosen to minimize species misidentifications with other species of similar asters. Presence or absence was chosen because, compared to other measures, it is easy to determine, quickly counted, and produces parametric data that can be analyzed using standard statistics. In addition, compared to other measures, presence or absence is well-suited to small plots. The data will be the number of plots with flowering stems in the population; analyses of the data will use an analysis of variance [ANOVA] on repeated measures, with populations forming sampling blocks.

Figure 3. Diagram portraying the placement of the sampling points within the long-term monitoring plot design.



In addition to plot data, the investigator will take digital photographs of the population, using cardinal directions from the base stake.

C. Phase III – *Demographic/Population/Management Treatment Research*

At any time during the life of the CCA, Parties may elect to engage in more intensive population monitoring. The goal of Phase III is to collect formal demographic information on populations, for use in the development of population models such as Population Viability Assessment [PVA]. The expectation is that these actions will be designed by, and conducted under the auspices of, an expert in plant population

dynamics. Specific methods will be determined when one of the Parties engages in Phase III monitoring, and will be subject to review and approval of the other Parties. Phase III demographic monitoring will always be an optional action, although the expectation is that all Parties will be informed of the process, and will work cooperatively to further the goals of the monitoring process.

Research will be conducted on the effects of various management treatments being implemented on habitat in which Georgia aster occurs. The effects of current and future management treatments on multiple population variables (e.g., recruitment, flowering stems, number of rosettes, fruits per flower) will be examined. Research results will inform the adaptive management process, help identify best management practices for the long-term viability of the species, and may help formulate terms and language of future Georgia aster CCA extensions.

XII. Duration of the CCA and Termination by Any Party

Long-term protection and management, as outlined in this CCA, are necessary for the continued conservation of Georgia aster. The initial term of this CCA will be ten (10) years. This CCA shall be extended for additional five (5) year increments until long-term habitat management and conservation of Georgia aster is assured. Any Party may withdraw from this CCA upon sixty (60) days written notice to the other Parties.

Any Party may propose modifications to this CCA by providing written notice to the other Parties. Such notice shall include a statement of the proposed modification and the reason for the modification, such as information or new conservation management practices gained through adaptive management. The Parties will use their best efforts to respond to proposed modifications within 60 days of receipt of such notice. Proposed modifications will become effective upon the other Parties' written approval.

XIII. Reporting of Conservation Actions and Monitoring

The USFWS will convene the Parties annually to discuss and review both monitoring and management progress related to the CCA.

Each Party will maintain their own data for Phase II, and send electronic copies to the USFWS Asheville Ecological Services Field Office prior to each annual review of the CCA.

Implementation of the CCA will require the cooperation of state Natural Heritage Programs. Data collection and monitoring protocols for Georgia aster agreed to in this CCA are the minimum requirements for monitoring efforts. Each Party may adopt monitoring actions that are more rigorous if they are able.

XIV. Effect of the CCA in Event of Listing Decision

It is the intent and expectation of the Parties that the execution and implementation of this CCA will lead to the conservation of Georgia aster in its range. If, subsequent to the effective date of this CCA, the Secretary of the Interior should determine pursuant to section 4(a) of the ESA (16 U.S.C. §1533(a)), that Georgia aster is threatened or endangered, the Parties will be encouraged to participate in recovery planning for Georgia aster. It is also the expectation of the Parties that the conservation and management commitments made in this document will be considered in the event of a listing under the ESA.

XV. Definitions

Achene - small, dry, one-seeded fruit

ANOVA – analysis of variance, a statistical method in which variation in a set of observations is divided into distinct components

CCA – Candidate Conservation Agreement

Cryopreservation – a process where cells, whole tissues, or any other substances susceptible to damage caused by chemical reactivity or time are preserved by cooling to sub-zero temperatures

Ecotype - a distinct form of a plant or animal species occupying a particular habitat

EO – element occurrence

Lanceolate - narrow, and tapering toward the apex of the leaf

NatureServe’s Habitat-based Plant Element Occurrence (EO) Delimitation Guidance – addresses whether two separate observations of the same element belong to the same EO, or to two different EOs, in the absence of more specific guidance

Oblanceolate - having a rounded apex and a tapering base

Rhizomes- horizontal underground stems that put out lateral shoots and adventitious roots at intervals

Scabrous - having small raised dots, scales or points

Trichomes - small hairs from the outer layer of a plant

U.S. Forest Service Sensitive Species – animal and plant species which receive special emphasis in planning and management activities on National Forest System lands to assure their conservation

XVI. References

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APPENDIX A: SIGNATURE PAGES

GEORGIA ASTER CANDIDATE CONSERVATION AGREEMENT

The following page will be reproduced as necessary to facilitate the signature of the Candidate Conservation Agreement by the appropriate Party representatives. It is anticipated there will be one Signature per page.