Recovery Outline

for

***Helianthus verticillatus* (whorled sunflower)**

September 2014

I. INTRODUCTION

This document outlines a preliminary course of action for the recovery of *Helianthus verticillatus* until a comprehensive recovery plan for the species is approved. *Helianthus verticillatus* (Family: Asteraceae) is a perennial herb arising from horizontal, tuberous-thickened roots with slender rhizomes, producing stems that can reach 4 meters (m) (13 feet (ft)) or more in height (Matthews *et al*. 2002). The leaves are opposite on the lower stem, verticillate (whorled) in groups of three to four at the mid-stem, and alternate or opposite in the inflorescence (flower bearing portion of a plant). Individual leaves are firm in texture and have a prominent mid-vein, but lack prominent lateral veins found in many members of the genus. The flowers are arranged in a branched inflorescence typically consisting of three to seven heads, each with deep yellow ray flowers and lighter yellow disk flowers. The current range of *H. verticillatus* includes isolated populations in Cherokee County, Alabama; Floyd County, Georgia; and McNairy and Madison Counties, Tennessee. The species was listed as endangered on August 1, 2014 (79 FR 44718). The primary threat to this plant is habitat loss from mechanical or chemical vegetation management for industrial forestry, right-of-way maintenance, or agriculture; additional threats include shading and competition resulting from vegetation succession, limited distribution, and small population sizes.

Listing and Contact Information:

Listing Classification:	Endangered range-wide
Effective Listing Date:	September 2, 2014
Lead Agency, Region:	U.S. Fish and Wildlife Service, Southeast Region
Lead Field Office:	Tennessee Ecological Services Field Office
Contact Biologist:	Geoff Call, 931-525-4983, geoff_call@fws.gov

II. RECOVERY STATUS ASSESSMENT

A. Distribution and Status

[Note: For a more detailed description of this sunflower's distribution and status, please see 78 FR 47109 published on August 2, 2013.]

There are four *Helianthus verticillatus* populations known to be extant, each consisting of multiple tracked subpopulations (Table 1) (Alabama Natural Heritage Program (ANHP) 2012, Georgia Department of Natural Resources (GDNR) 2014, Tennessee Natural Heritage Inventory Database (TNHID) 2012). In Floyd County, Georgia, there is one population comprised of four subpopulations. There is one population in Cherokee County, Alabama, comprised of two subpopulations. Populations in Georgia and Alabama are less than 2 km (1.2 mi) apart. In Tennessee, there is one population comprised of six subpopulations in McNairy County and one population comprised of four subpopulations in Madison County. Table 1 lists these populations and subpopulations, and relates them to EO numbers used by State conservation agencies to track their status.

TABLE 1.—List of *Helianthus verticillatus* populations and subpopulations by State and county, with corresponding site names and element occurrence (EO) numbers from State conservation agency databases in Alabama, Georgia, and Tennessee.

Population (County, State)	Subpopulation Number(s)	Site Name	Heritage EO Number
Cherokee, AL	1	Kanady Creek Prairie	AL_1
	2	Locust Branch Prairie	AL_2
Floyd, GA	1	Jefferson Road Wet Prairie	GA_1
	2	Kanady Creek Wet Prairie	GA_4
	3	Upper Mud Creek Wet Prairies	GA_5
	4	Sunnybell Prairie	GA_7
Madison, TN	1 - 6	Turk Creek	TN_2
McNairy, TN	1 - 4	Prairie Branch	TN_3

The population in Floyd County, Georgia, is located on lands owned by Plum Creek, a land and timber company. This site is referred to as the Coosa Valley Prairie and is protected by a conservation easement held by The Nature Conservancy, which jointly manages the property with Plum Creek. All other sites are on private lands but are not protected.

Initial efforts to estimate population sizes of *Helianthus verticillatus* relied on counting individual stems (Allison 2002, Schotz 2001); however, due to the species' clonal growth habit, stem counts overestimate the true number of genetically distinct individuals (genets). Ellis *et al*. (2006) found that the genetic population size is much smaller than the number of stems in a population and that a more accurate population census could be made at most *H. verticillatus* sites by counting obvious clusters of stems rather than individual stems. However, Mandel (2010) reported that individual clusters were much less distinct in a portion of the Alabama site she sampled.

B. Habitat

[Note: For a more detailed description of this sunflower's habitat, please see 78 FR 47060 and 78 FR 47109, published on August 2, 2013.]

Helianthus verticillatus is found in moist, prairie-like remnants, which in a more natural condition exist as openings in woodlands and adjacent to creeks. The Alabama and Georgia populations are located on flat to gently rolling uplands and along stream terraces in the headwaters of Mud Creek, a tributary to the Coosa River. In Tennessee, the Madison County population occurs along Turk Creek, a tributary to the South Fork Forked Deer River, and in adjacent uplands. The McNairy County population occurs along Prairie Branch, a headwater tributary to Muddy Creek in the Tuscumbia River drainage. The soil types where *H. verticillatus* occurs are silt loams, silty clay loams, and fine sandy loams. These soils share the characteristics of being strongly to extremely acidic and having low to moderate natural fertility and low to medium organic matter content (USDA 1997, USDA 1978a, USDA 1978b, USDA 1978c).

Dominant grasses associated with *H. verticillatus* habitat include *Schizachyrium scoparium* (little bluestem), *Sorghastrum nutans* (Indian grass), *Andropogon gerardii* (big bluestem), and *Panicum virgatum* (switch grass). Other common herbaceous associates include *Bidens bipinnata* (Spanish needles), *Carex cherokeensis* (Cherokee sedge), *Hypericum sphaerocarpum* (roundseed St. Johnswort), *Helianthus angustifolius* (swamp sunflower), *Helenium autumnale* (common sneezeweed), *Lobelia cardinalis* (cardinal flower), *Pycnanthemum virginianum* (Virginia mountainmint), *Physostegia virginiana* (obedient plant), *Saccharum giganteum* (sugarcane plumegrass), *Silphium terebinthinaceum* (prairie rosinweed), *Sporobolus heterolepis* (prairie dropseed), and *Symphyotrichum novae-angliae* (New England aster) (Tennessee Division of Natural Areas 2008, Matthews et al. 2002, Schotz 2001).

Encroachment by woody vegetation is a threat to *Helianthus verticillatus* populations when left unmanaged in old fields, transportation rights-of-way, and borders of agricultural fields, as well as in densely shaded silvicultural plantations or forested sites. To prevent excessive shading or competition, these sites should be subjected to periodic disturbance or management to reduce or minimize encroachment of woody vegetation where a forest canopy is not present, or to provide low levels of canopy and midstory closure where they occur in woodlands.

Critical Habitat

The Endangered Species Act and its implementing regulations require us to identify the physical or biological features essential to the conservation of *Helianthus verticillatus* in areas occupied at the time of listing, focusing on the features' primary constituent elements (PCEs). PCEs are

those specific elements of the physical or biological features that provide for a species' life-history processes and are essential to the conservation of the species. Based on our current knowledge of the physical or biological features and habitat characteristics required to sustain the species' life-history processes, we determined that the PCEs for *H. verticillatus* are:

> (1) Silt loam, silty clay loam, or fine sandy loam soils on land forms including broad uplands, depressions, stream terraces, and floodplains within the headwaters of the Coosa River in Alabama and Georgia and the East Fork Forked Deer and Tuscumbia rivers in Tennessee.
>
> (2) Sites in which forest canopy is absent, or where woody vegetation is present at sufficiently low densities to provide full or partial sunlight to *H. verticillatus* plants for most of the day, and which support vegetation characteristic of moist prairie communities. Invasive, nonnative plants must be absent or present in sufficiently low numbers not to inhibit growth or reproduction of *H. verticillatus*.
>
> (3) Occupied sites in which a sufficient number of compatible mates are present for outcrossing and production of viable achenes to occur.

The Service designates critical habitat based on availability of the PCEs for a given species, delineating those areas we have determined to be essential for the species' conservation. We designated approximately 624.2 ha (1,542.3 ac) of critical habitat for *H. verticillatus,* distributed among four units in Cherokee County, Alabama; Floyd County, Georgia; and Madison and McNairy Counties, Tennessee (Table 2)(79 FR 51039). All units are privately owned and were considered occupied at the time of listing.

TABLE 2. Designated critical habitat units for *Helianthus verticillatus*.

Critical Habitat Unit	County, State	Hectares	Acres
1. Mud Creek	Cherokee, Alabama	210.6	520.4
2. Coosa Valley Prairie	Floyd, Georgia	366.9	906.5
3. Prairie Branch	McNairy, Tennessee	6.0	14.9
4. Pinson	Madison, Tennessee	40.7	100.5
TOTAL		**624.2**	**1,542.3**

C. Biology

Helianthus verticillatus is a self-incompatible, clonal perennial that flowers from August into October (Matthews *et al*. 2002, Ellis and McCauley 2008). The species is easily cultivated and seed germination is high in the laboratory. Upon transplanting, this species has been shown to reproduce rapidly from rhizomes (a horizontal underground stem that produces roots and shoots), creating dense colonies. Ellis *et al*. (2006) investigated genetic diversity in the Georgia, Alabama, and Madison County, Tennessee, populations of *H. verticillatus* and found high levels of genetic diversity at the population and species levels despite its apparent rarity. They speculated that this is indicative of a species that was more widespread in the past and perhaps became rare relatively recently (Ellis *et al*. 2006). *H. verticillatus* populations exhibited moderate levels of differentiation based on markers that are presumed to be selectively neutral,

and since these populations are geographically distinct and ecological conditions vary somewhat among them Ellis *et al*. (2006) concluded that they likely are as differentiated, if not more so, at adaptive loci.

Ellis and McCauley (2008) investigated whether there were differences among populations of *Helianthus verticillatus* with respect to achene (seed) viability and germination rates and whether those differences might have a genetic basis. They conducted this experiment for two generations of plants, the second generation produced from intra-population crosses of first generation plants. They also explored whether isolation of populations from one another could have fitness consequences, by conducting inter-population crosses and evaluating whether they found: (1) Evidence of genetic rescue expressed as higher fitness of hybrid individuals as compared to any or all of the parental populations; and (2) evidence of outbreeding depression. Their study included material from the Alabama, Georgia, and Madison County, Tennessee, populations. However, they were unsuccessful in cultivating plants from the Georgia population, where the flower heads contained few viable achenes, which produced low germination rates (Ellis and McCauley 2008).

The number of crosses that produced no viable achenes was higher in the intra-population Tennessee crosses than in any other pair of crossings. Those achenes that were produced by first generation Tennessee intra-population crosses exhibited lower germination rates than Alabama achenes, and second generation Tennessee achenes from intra-population crosses exhibited both lower viability and germination rates than the Alabama achenes. However, survival rates of germinated achenes did not differ among these populations in either generation (Ellis and McCauley 2008). Ellis and McCauley (2008) suggested three possible mechanisms that could explain these results, none of which are mutually exclusive: (1) Limited mate availability in the Tennessee population due to limited diversity of self-incompatibility alleles; (2) more extensive inbreeding within the Tennessee population; or (3) differential adaptation between the two populations.

When Tennessee plants were crossed with pollen from Alabama plants, the second generation mean achene viability and germination rates were equal to or greater than those of Alabama intra-population crosses or Alabama plants crossed with pollen from Tennessee plants. Mean achene viability of Tennessee intra-population second generation crosses was lower than all other groups and germination rates were lower than both Alabama intra-population crosses and Alabama plants crossed with pollen from Tennessee plants (Ellis and McCauley 2008).

Based on their results, Ellis and McCauley (2008) concluded that populations of *Helianthus verticillatus* are not interchangeable with respect to phenotypic fitness-related characters (i.e., achene viability and germination rates) and suggested that the potential exists for genetic rescue of the Tennessee population by transplanting either seeds or seedlings produced from crosses between Tennessee and Alabama plants into the Tennessee population.

D. Threats Assessment

[Note: For a more detailed assessment of the listing factors as they relate to this sunflower, please see 78 FR 47109 published on August 2, 2013.]

Helianthus verticillatus appears to be a narrow habitat specialist, occurring in natural wet meadows or prairies and calcareous barrens. Such habitats likely were more extensive in the eastern United States before European settlement, subsequent fire suppression, and conversion of habitat to cropland or residential areas (Allison 1995). Today these prairie areas are not very extensive, and they often are degraded or have been destroyed for a number of reasons. Most remaining prairie vegetation in the geographic area where *H. verticillatus* occurs exists as remnants along roadside and utility rights-of-way, where prairie-like conditions are artificially maintained (Allison 1995). Where *H. verticillatus* habitat remains, it faces threats due to indiscriminate use of mechanical or chemical vegetation management for industrial forestry, right-of-way maintenance, or agricultural purposes. Because the species requires well-lit habitats for its growth and reproduction, shading and competition due to vegetation succession in the absence of natural or human-caused disturbance also threaten *H. verticillatus* habitat. Despite the fact that *H. verticillatus* is listed as endangered by the states of Georgia and Tennessee, these designations confer no guarantee of protection to the species or its habitat, whether on privately owned or state-owned lands, unless such protections are voluntarily extended to the species by owners or managers of lands where the species is present.

Helianthus verticillatus is vulnerable to localized extinction because of its extremely restricted distribution and small population sizes at most known locations, which reduces the resilience of these populations to recover from acute demographic effects of threats to its habitat. The highly fragmented distribution of populations within Tennessee, combined with their disjunct location with respect to those in Georgia and Alabama, presumably precludes gene flow among them and leaves little chance of natural recolonization of these populations in the event of localized extinctions. Small population size could be affecting reproductive fitness of the *H. verticillatus*. The findings of Ellis and McCauley (2008) suggest that the Madison County, Tennessee, population is reproductively less fit than the Alabama population. Ellis and McCauley (2008) offered two possible explanations for reduced reproductive fitness of the Tennessee population, including limited mate availability due to limited diversity of self-incompatibility alleles, or more extensive inbreeding. Both could be contributing to reduced seed production and viability rates.

E. Conservation Efforts

Status surveys have been conducted for this species throughout its range (Nordman 1998, 1999; Schotz 2001; Allison 2002; Lincicome 2003). Despite these extensive surveys, the number of known populations remains low. Schotz (2001) located 1 new population out of 44 attempts, representing a success rate of only 2 percent. Surveys during 2000 and 2002 in Tennessee were unsuccessful at locating any additional sites (Lincicome 2003). Surveys in 2006 resulted in discovery of the population in McNairy County, Tennessee (Tennessee Division of Natural Areas 2008).

Temple-Inland Corporation donated a conservation easement for the Coosa Valley Prairie property in Georgia to The Nature Conservancy, thereby protecting most of the Georgia population of this species. This site drains into the headwaters of Mud Creek. In 2002, The Georgia Department of Natural Resources and The Nature Conservancy worked with staff of Temple-Inland to develop a 10-year management plan for conservation of rare species within this easement area. Site-specific management plans for several open wet prairies, known to provide habitat for this species within the easement, were developed. Temple-Inland implemented a prescribed burn and selective timber harvest on 243 ha (600 ac) of the easement in 2001, to improve habitat conditions for *Helianthus verticillatus* and other species. Temple-Inland conducted additional burns within the easement area between 2002 and 2006. Mechanical thinning and control of invasive, exotic plants was also a component of their management of this site.

This easement area, now owned by Plum Creek, is cooperatively managed with The Nature Conservancy based on a jointly developed conservation management plan, which was revised in 2012, for the period extending through 2016. The management goals for the site are based on the conservation easement and include long-term perpetuation and restoration of the mosaic of prairies, woodlands, wetlands, creeks, and forest while allowing for sustainable timber harvesting. Protecting and enhancing native plant communities, especially those supporting rare species, is the primary management objective, and periodic timber harvesting is a secondary objective. Portions of the tract either have been or will be planted into *Pinus palustris* (longleaf pine) as part of the Longleaf Alliance partnership. Prescribed fire is the primary management tool used to perpetuate and restore the native plant communities and also serves silvicultural objectives.

Despite the existence of a conservation plan and the cooperative partnership between The Nature Conservancy and Plum Creek to implement the plan, management with prescribed fire is not a binding condition of the conservation easement. Thus, the potential remains that this management could be discontinued if the property were sold to a less cooperative landowner.

III. PRELIMINARY RECOVERY STRATEGY

A. Recovery Priority Number with Rationale

Helianthus verticillatus is assigned a recovery priority number of 2, which indicates the species faces a high degree of threat but also has high recovery potential. Despite its restricted and fragmented geographic range and small population sizes, we consider the recovery potential to be high for *H. verticillatus* because threats to the species' habitat are reasonably well understood and manageable. The population at Coosa Valley Prairie has responded well to conservation efforts using prescribed fire management to maintain the open, well-lit conditions the species favors. While the other three populations currently are not protected or receiving appropriate habitat management, efforts to engage landowners in cooperative conservation efforts to restore or maintain wet prairie or woodland habitat conditions could be successful in recovering the species. If landowners are unwilling to cooperatively manage habitat for the species, during preparation of the official recovery plan or future 5-year reviews of the species' status we would likely change the recovery priority number to reflect a low recovery potential.

B. Recovery Strategy

Survival of *Helianthus verticillatus* now depends on protecting the species' occupied and suitable habitat from further degradation and fragmentation; restoring potentially suitable habitat within its historical range; evaluating and reducing threats from incompatible land uses, shading, and nonnative plants; increasing the current populations in size; conserving genetic diversity; and potentially establishing populations where suitable conditions are present on protected lands.

Because of the very restricted range of *Helianthus verticillatus*, the recovery strategy will initially focus on protecting known populations. We will first work to establish a conservation agreement to protect the Alabama subpopulation that is located on Plum Creek property. With this conservation agreement, we would seek commitments from Plum Creek to restore habitat and encourage demographic and spatial expansion of the subpopulation, which is currently threatened by silvicultural practices for pine production. Protecting the other Alabama subpopulation and the Tennessee populations will require establishing contact with multiple private landowners, county highway departments and state departments of transportation, Norfolk Southern railway, and utility providers. The Service will work with State conservation agencies, Natural Resources Conservation Service, and non-profit conservation organizations to engage landowners and attempt to establish conservation agreements to protect and restore habitat conditions favorable to population growth for *H. verticillatus*. Outreach and education to inform the public about the existence of *H. verticillatus*, the habitat the species prefers, and opportunities to participate in conservation efforts will be important components of the recovery strategy.

Efforts to locate suitable habitat and additional populations of *Helianthus verticillatus* will continue. Absent the discovery of additional populations, it could become necessary to establish populations through reintroduction into suitable habitat where it is present on protected lands. If habitat conservation is not effective in stimulating growth of existing populations, augmentation using seed or nursery-propagated plants could become necessary.

Monitoring stage-specific (e.g., seedlings, vegetative, and reproductively active plants) abundance will be necessary to determine whether habitat conservation efforts are sufficient for eliciting increases in *Helianthus verticillatus* populations. The achene viability and germination rate study by Ellis and McCauley (2008) indicates that there could be a need for facilitating gene flow among the isolated populations to increase production of viable achenes. If stage-specific monitoring does not demonstrate positive responses to habitat management efforts, demographic monitoring should be implemented to determine which life history stages are not sufficiently abundant to maintain population viability. The results from demographic monitoring should be used in determining whether exchanging genetic material in the form of pollen transfer or introduction of seed or plants from other populations should be considered.

C. Initial Action Plan

Anticipated Recovery Actions in relation to our recovery strategy described above:

1. Work with Plum Creek to establish a conservation agreement or easement for the Kanady Creek Prairie subpopulation in Alabama.

2. Work with State and private landowners in Tennessee and Alabama to obtain protection for populations. Potential mechanisms include fee simple purchase, conservation easement, or establishing a conservation agreement to ensure habitat receives necessary management and is protected from incompatible land uses.
3. Develop agreements with Departments of Transportation, railroad authorities, and powerline companies to ensure protection of populations extending onto rights-of-ways in Tennessee and Alabama.
4. Encourage and support additional surveys for populations.
5. Conserve germplasm (genetic material; e.g. seed) and promote genetic diversity.
6. Establish methods to effectively monitor, and if necessary, reintroduce *Helianthus verticillatus*.
7. Initiate regular stage-specific monitoring at each site, to include counts from discrete clusters, where possible. Monitoring should include periodic checks of achene formation, viability, and germination rates, in order to evaluate whether diminished reproductive fitness poses a long-term threat to populations.
8. If low reproductive fitness is consistently observed at populations, further study should be done to identify likely causes and design management strategies to improve reproductive fitness in populations where the threat is most pronounced.
9. Determine the number of populations required to recover *Helianthus verticillatus* – i.e., to reduce the risk of extinction to the point that the species is no longer threatened or endangered.
10. Continue to coordinate with Federal, State, and County agencies to promote plant recovery and find innovative ways to increase public awareness of the need to protect this species and its habitats.

IV. PREPLANNING PROCESS

We will prepare a recovery plan for *Helianthus verticillatus* that includes objective and measurable criteria which, when met, will ensure the conservation of the species. Recovery criteria will address all meaningful threats to the species, as well as estimate the time and the cost to achieve recovery. The recovery plan will be prepared by the Tennessee Field Office. The draft recovery plan should be finalized and sent to the Regional Office for review in February 2016. The final recovery plan should be finalized and sent to the Regional Office for review by September 2017. These timelines may be affected by available resources and regional priorities. During the recovery planning process, input, comments and review will be sought from multiple stakeholders within the States of Alabama, Georgia, and Tennessee. These will include State and Federal agencies, industrial and agricultural groups, research universities, and conservation organizations.

Approved:

Assistant Regional Director, Region 4
U.S. Fish and Wildlife Service

10/23/14
Date

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