Schweinitz's sunflower *(Helianthus schweinitzii)*

5-Year Review:
Summary and Evaluation

U.S. Fish and Wildlife Service
Asheville, North Carolina, Field Office
Asheville, North Carolina

*Please see Addendum 1 at the end of this, our original 5-year review, document. The Addendum provides the limited new information we have gathered for our second 5-year review for this endangered plant that was initiated in the Federal Register (August 6, 2018; 84 FR 38320) and the analysis we have shared to explain the basis for continuing to recommend no change in status for this species.

5-YEAR REVIEW
Schweinitz's sunflower/*Helianthus schweinitzii*

I. GENERAL INFORMATION

A. Methodology used to complete the review

Public notice of this 5-year review was given in the Federal Register on September 20, 2005 (70 FR 55157) and a 60 day comment period was opened. During the comment period, we did not receive any additional information about Schweinitz's Sunflower other than responses to specific requests for information from biologists familiar with the species. Information used in this report was gathered from published and unpublished reports. Records were provided by North Carolina and South Carolina Natural Heritage Program offices. Once all data was gathered/obtained, the review was completed by the lead recovery biologist for the species in Asheville, North Carolina. A draft of this review was also circulated to those familiar with the species (Appendix A, Peer Review).

B. Reviewers

Lead Regional– Southeast Region: Kelly Bibb, 404/679-7132

Lead Field Office – Asheville, North Carolina, Ecological Services, Carolyn Wells, 828/258-3939 extension 231

Cooperating Field Office(s) – Charleston, South Carolina, Ecological Services, Lora Zimmerman, 843/727-4707 extension 226 (now with the Service's Washington Office); Raleigh, North Carolina, Ecological Services, Laura Fogo, 910/695-3323 extension 4; and Dale Suiter, 919-856-4520 extension 18.

C. Background

1. FR Notice citation announcing initiation of this review:

September 20, 2005 (70 FR 55157)

2. Species status

Uncertain (FY 2009 Recovery Data Call). The majority of sites are not monitored annually, or in any manner capable of assessing year-to-year fluctuations in status and trends. In recent years, numerous observers have suggested stem counts are down, presumably due to drought. However these observations have occurred at too few sites to be regarded as representative of the entire range. Therefore, the overall status over the past year is reported as "unknown".

3. Recovery achieved

2 (26-50% recovery objectives achieved).

4. Listing history

Original Listing
FR notice: 56 FR 21807-21091
Date listed: May 7, 1991
Entity listed: Species
Classification: Endangered

5. Associated rulemakings

None.

6. Review History

1994 Recovery Plan
Recovery Data Call: 2009, 2008, 2006, 2005, 2004, 2003, 2002, 2001, and 2000

7. Species' Recovery Priority Number at start of review (48 FR 43098):

5, corresponding to "high" magnitude of threat, "low" recovery potential, and taxonomic status of "species"

8. Recovery Plan

Name of plan: U.S. Fish and Wildlife Service. 1994. Recovery Plan for Schweinitz's sunflower (*Helianthus schweinitzii*).

Date: April 22, 1994.

II. REVIEW ANALYSIS

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

The Act defines species as including any subspecies of fish or wildlife or plants, and any distinct population segment (DPS) of any vertebrate fish or wildlife. Because *Helianthus schweinitzii* is a plant, the DPS policy is not applicable and not addressed further in this review.

B. Recovery Criteria

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

Yes, the species has a final, approved plan. The criteria are generally objective and measurable, however some would benefit from refinement. See below.

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. Although knowledge of the species' biology and applicable threats has not changed appreciably since the recovery plan was written, the species' distribution (and therefore the range of occupied habitat) has expanded beyond that described in the recovery plan. As a result, it would be possible to meet the current set of recovery criteria without ensuring that protected self-sustaining populations are distributed throughout the species' current range.

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. It would not be possible to fulfill the existing recovery criteria without addressing the three listing factors identified in the listing rule (habitat loss, the inadequacy of existing regulatory mechanisms, and other natural or manmade factors). However, disease/predation was not recognized as a significant factor in the listing rule, and has since been identified as a significant threat at some transplanted populations. Some observers have reported as much as 80-90% of transplants being consistently browsed in recent years (Frazer, 2010).

Overutilization was not regarded as significantly affecting the species, and there is no new information to suggest that this factor has since become a significant threat to the species.

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

Criteria for reclassification to threatened:

10 geographically distinct, self-sustaining populations are protected in at least 4 counties in North Carolina and one in South Carolina

Criterion not met. Portions of 24 geographically distinct populations (20 in North Carolina and four in South Carolina) are in some form of protective ownership (Appendix B, Tables B.1 and B.2). These populations are distributed across eight counties in North Carolina and one county in South Carolina. However, each of these populations consists of multiple sites, only some of which are in protective ownership. Therefore, significant portions of each population remain vulnerable to identified threats operating against the species. Given the piecemeal nature of protection within these 24 populations, it is currently unlikely that any one of them is self-sustaining. However, a lack of basic life history information (esp. recruitment and mortality rates) continues to hinder objective definition of what constitutes a self-sustaining population in this species.

As a result, this component of this criterion cannot be objectively assessed. Further, without increased monitoring effort, it will be impossible to assess whether populations are self-sustaining even after this criterion can be objectively defined for this species.

Managers have been designated for each population

Criterion not met. Inasmuch as portions of the 24 geographically distinct populations discussed above are owned by natural resource agencies or conservation organizations, some level of management can be inferred from patterns of landownership (Appendix B, Tables B.1 and B.2). However in most cases management roles and responsibilities have not been explicitly articulated or formalized.

Management plans have been developed and implemented

Criterion not met. Draft or final management plans exist for many subpopulations, but few of these have been integrated into management plans for the larger population of which they are a part (Appendix B, Tables B.1 and B.2). Those management plans that do exist typically apply only to portions of the population in protective ownership. Equally varied is the extent to which these plans have been implemented, and in still other cases management has been implemented in the absence of explicit (written) management plans. Across the range of the species, implementation of management is limited by expertise and resources. This recovery criterion is somewhat subjective and should be revised to emphasize the importance of adequate, iterative management in perpetuity.

Populations have been maintained for 5 years

Criterion not met. None of the populations receiving repeat monitoring currently show a steadily increasing trend over a period of five years. For most sites, these trends cannot be assessed either because sufficient data do not exist, or because available data are not comparable (counts or estimates have been reported in different units (stems, clumps, etc.) or apply to different portions of a given site).

Criteria for removal from the Federal list (de-listing):

- 15 geographically distinct, self-sustaining populations are protected in at least 4 counties in North Carolina and one in South Carolina
- Management plans have been implemented
- Populations (as measured by number of adult plants) have been stable or increasing for 10 years
- Permanent conservation ownership and management of at least 10 populations are assured by legally binding agreements

These criteria are not discussed further because they are the same or stricter than the criteria for reclassification to threatened status, which are discussed above and have not been met.

C. Updated Information and Current Species Status

1. Biology and Habitat

a. Abundance, population trends (e.g. increasing, decreasing, stable), demographic features (e.g., age structure, sex ratio, family size, birth rate, age at mortality, mortality rate, etc.), or demographic trends:

Abundance

When the species was federally-listed in 1991, there were a total of 13 extant populations (eight in NC and five in SC). The 1991 listing rule apparently treated each known Natural Heritage Program (NHP) element occurrence (EO) for the species as a distinct population.

At the time of this review, there were 165 EO records in the North Carolina NHP database (NC NHP 2006). These aggregate into 78 potential populations of the species. In South Carolina, there are eight geographically distinct areas which approximate populations of the species (Houk 2003; Appendix B, Table B.2). Therefore, the total known range consists of some 86 populations, 78 in North Carolina and eight in South Carolina.

The 1991 listing rule did not indicate the number of plants within the 13 populations known to be extant at that time. However, supporting information suggests that these sites collectively contained some 2,805 stems.[1] As of this review, available data suggests that sites with some potential to provide a role in recovery collectively contain over 40,000 stems (Appendix B, Tables B.1 and B.2).

Trends

All of the 24 populations with the potential to provide permanent protection are monitored (or are expected to be monitored) on a regular basis, although the frequency and type of monitoring varies by site. Regardless, none of these populations currently show a steadily increasing trend over a period of five years. For most sites, comparable (year-to-year) counts or estimates are not available for one or more of the following reasons: either sufficient data do not exist, counts have been reported in different units (e.g., total stems, flowering stems only, or clumps) from one observation to the next, or the count/estimate applies to different portions of a given site.

In terms of the numbers of known populations and individuals, the abundance of this species is greater than it was at the point of listing. However, Houk (2003) has emphasized that stem and/or clump counts in *H. schweinitzii* are "quite variable" from year to year (even in the absence of obvious influence from restoration efforts or mismanagement). Houk arrived at this conclusion after years of sustained monitoring

[1] This is conservative in that it is based upon the lowest count or estimate available for each site as of that time.

efforts conducted across multiple sites in South Carolina. As a result, his observations control for discrepancies that may have otherwise been introduced by different observers.

Unfortunately very few North Carolina sites have been monitored this consistently; therefore assessments of trends in abundance in that portion of the species' range are more difficult to interpret. In nearly all of these instances, one or more persons familiar with the site have questioned the degree to which the observations accurately reflect actual trends as opposed to incomparable counts/estimates. We are working to extract and verify reliable trend data from available reports and other sources; however this information was not available at the time of this review. The Service expects that trends can ultimately be determined for at least some of the sites currently or expected to be under protective ownership/management.

Population demographics

We are aware of only one effort to examine demographic trends in this species. However, the only report in apparent direct reference to this work is an interim report which states that demographic data would be compiled and submitted for publication at a later time (Barden, 2000). We do not have any such subsequent report, and efforts to obtain the raw data have been unsuccessful. Inspection of available data suggests that individual plants were not followed over time, therefore patterns of recruitment and mortality may be difficult to interpret. The primary investigator involved with this effort does not deem the effort worthy of publication, and regards the level of year-to-year variation in stem counts as too great to produce meaningful predictions of extinction risk (Barden, personal communication).

b. Genetics, genetic variation, or trends in genetic variation (e.g., loss of genetic variation, genetic drift, inbreeding, etc.):

Matthews and Howard (1999) reviewed genetic variation in 25 sites occupied by the species, as detected by allozyme loci.[2] Low levels of genetic variation among populations were detected, and genetic differentiation among sites was not correlated with geographic distance. The results support a hypothesis of relative fragmentation of a formerly large, contiguous (panmictic) population into more isolated groups. They hypothesized that restoration and relocation efforts would have relatively low risk of generating outbreeding depression, and that recovery efforts should therefore focus on establishing protected sites which could be subjected to appropriate management.

Savin (2003 and 2006, pers. comm.) used microsatellites, a molecular marker regarded as having a higher probability of detecting genetic differences at the population level. Savin collected material from one site in each of seven counties across the species' range. Her results generally corroborated those of Matthews and Howard (1999), in that populations

[2] The authors referred to their sites as populations, however since the identity of these sites was not revealed, and the geographic distance between them is unknown, we are conservatively referring to these as "sites" rather than "populations" here.

showed small levels of differentiation relative to published accounts from other plant species (Savin, 2006). Savin interprets these results as suggesting that relocation over relatively short distances (e.g., within a county) presents little risk of outbreeding depression.

c. Taxonomic classification or changes in nomenclature:

We are not aware of any published or proposed changes in taxonomy or nomenclature which would influence the classification of this species or affect its legal status as a listed entity under the Act.

d. Spatial distribution, trends in spatial distribution (e.g. increasingly fragmented, increased numbers of corridors, etc.), or historic range (e.g. corrections to the historical range, change in distribution of the species' within its historic range, etc.):

The 1991 listing rule referenced 13 extant populations distributed across five NC counties (Cabarrus, Mecklenburg, Rowan, Stanly and Union) and one SC county (York). As of this review, the species' distribution includes 13 NC counties (the original five plus Anson, Davidson, Gaston, Montgomery, Randolph, Richmond, Stokes, Surry) and two SC counties (Lancaster and York).

e. Habitat or ecosystem conditions (e.g., amount, distribution, and suitability of the habitat or ecosystem):

When the species was federally listed in 1991, 11 of the 13 known extant populations occurred in roadside or power line ROW (right-of-way) (USFWS, 1991). Five of the eight known extant NC populations were located within NCDOT ROW, two were in SCDOT ROW, one occurred on land managed by the Rock Hill (South Carolina) Department of Parks, Recreation and Tourism, and the remaining five occurred on privately owned lands "usually in or near transmission line corridors of various utility companies" (USFWS 1991).

Bates (2003) and Houk (2003) both ranked sites as to whether or not they occurred (in whole or in part) in ROW habitat. Bates assessed a total of 98 sites, 87 (88.7%) of which occurred in ROW. Houk assessed a total of 69 sites, 53 of which (76.8%) occurred in ROW. Therefore, out of 167 sites assessed by these two investigators, 156 (93.4%) occur in ROW where they are inherently in danger of inappropriate management and possible extirpation.

Habitat for the species continues to become increasingly fragmented with the rapid urbanization of the Charlotte, NC metropolitan area. The greater Charlotte-Gastonia-Concord area of North and South Carolina was identified as one of 35 fastest growing large metropolitan areas in the country in a recent report examining the effects of sprawl upon endangered species (Ewing et al. 2005).

f. Other:

No additional information beyond that already presented.

2. Five-Factor Analysis

a. Present or threatened destruction, modification or curtailment of its habitat or range:

The 1991 final listing rule described the following threats to extant populations: loss of historic levels of natural disturbance from fire and grazing by native herbivores, residential and industrial development, mining, encroachment by invasive species, highway construction and improvement, utility right-of-way maintenance, and herbicide use. Fire suppression and absence of grazing were addressed in detail under listing factor 5, but because these threats also constitute sources of habitat destruction or modification they are discussed here for purposes of this review.

The limited geographic range and scarcity of seed sources, as well as appropriate habitat, were also listed as threats in the 1991 final listing rule. Since that time, the known geographic range has expanded to include eight additional counties in NC and one additional county in SC. Expansion of the known range beyond the greater Charlotte metropolitan area has enhanced the potential for recovery in other portions of the species' range (e.g., the Uwharrie portions of the NC Piedmont). However, threats to the species continue to escalate with rapid urbanization and suburban sprawl in the greater Charlotte area. Throughout the species' range, over 90% of known sites occur in managed ROW, where vegetation management practices occasionally mimic patterns of natural disturbance (from fire or native grazers) now largely absent from the present day landscape. However, these same vegetation management practices pose a threat to these occurrences, in that inappropriately timed mowing (e.g., during the growing season, prior to seed set) or excessive herbicide application have adversely impacted the species at several of these locations. Many of these ROW occurrences are along existing roads which are subject to widening and improvement projects which disturb or eliminate the existing adjacent ROW. The NCDOT has a program in which roadside occurrences of federally listed plant species are posted with signs prohibiting growing season mowing or herbicide application. Despite these efforts, 28 of 63 NCDOT sites containing *H. schweinitzii* were reportedly adversely impacted at least once as of 2003 (Appendix C of Bates' 2003 report contains a spreadsheet of NCDOT roadside occurrences and information on impacts to these sites).

As such, recovery efforts are now focused upon relocating plants from these inherently vulnerable ROW habitats into adjacent areas with the potential for adequate management and the appropriate suite of associated native vegetation thought to comprise the natural plant communities of the Carolina piedmont ecoregion.

b. Overutilization for commercial, recreational, scientific, or educational purposes:

When the species was federally listed, this was not known to be a significant factor affecting the status of the species. However, the potential for such activities to be encouraged through increased public awareness of and interest in the species was acknowledged in the listing rule. We have no new information to suggest that this is a significant factor affecting the species at this time.

c. Disease or predation:

When the species was federally listed, this was not known to be a significant factor affecting the status of the species. Since that time, there are some indications that deer browse may be significantly affecting the survival of transplanted individuals and some native, resident populations (Frazer, 2010). However, the severity and geographic scope of this threat needs further investigation. This threat may now constitute a significant threat to the species if left unaddressed.

d. Inadequacy of existing regulatory mechanisms:

The overwhelming majority of statutory or regulatory mechanisms capable of affording protection to *Helianthus schweinitzii* stem from the species' Federal status under the Endangered Species Act of 1973, as amended. This statute provides various protections to this species that would not otherwise occur under any other Federal, state, or local statute. I n particular, federally funded activities with the potential to affect this species authorized, funded or otherwise carried out by Federal agencies are subject to section 7 consultation with the Service to ensure that such actions do not jeopardize the continued existence of the species. Section 7(a)(1) of this statute also directs Federal agencies to utilize their authorities to assist the Service in the recovery of species (such as *H. schweinitzii*) listed under this statute.

The North Carolina Plant Protection Act regulates collection and commercial trade (without a permit) of plants listed under the statute. However, this statute does not protect the species or its habitat from destruction in conjunction with development projects or otherwise legal activities.

South Carolina State Code (§50-11-2200) prohibits gathering, damaging or destroying plants (of any species) on lands owned by the South Carolina Department of Natural Resources (SCDNR), except by permit. Because *H. schweinitzii* occurs on two Heritage Preserves owned by SCDNR, the species is afforded some level of protection from damage, collection or destruction on those properties. However, the majority of sites containing the species in that state do not occur on SCDNR lands.

There are no other state, county, or local statues specifically affording protection to *H. schweinitzii* within the states of North and South Carolina. Regulatory mechanisms are inadequate for this species.

e. Other natural or manmade factors affecting its continued existence:

The 1991 final listing rule addressed low genetic variation and small population size, fire suppression and absence of grazing by large native herbivores under this listing factor. However, for purposes of this review, each of these threats have been addressed under Section II.C.2.a, above.

D. Synthesis

When the species was federally-listed in 1991, there were a total of 13 extant populations (eight in NC and five in SC). As of this review, the total known range consisted of some 86 populations, 78 in NC and eight in SC. However, these populations are typically small and highly fragmented, and 93 % of the sites (meaning spatially discrete portions of populations) containing the species occur in ROW where they are inherently in danger of inappropriate management practices and possible extirpation.

Portions of 24 extant populations (distributed across eight NC counties and two SC counties) have been identified as having a *potential* to meet some of the recovery criteria for the species (Appendix B, Tables B.1 and B.2). Of the 24 extant populations with some protection potential, 22 (distributed across seven NC counties and one SC County) are in some form of ownership and management that could provide permanent protection to the species. Portions of ten of these 22 populations have written management plans with components explicit to Schweinitz's sunflower, however implementation of these plans is a challenge at all locations due to lack of resources. Management plans are in draft for portions of the remaining 12 other populations whose current ownership may provide (or has indicated willingness to provide) permanent protective ownership. All of the 28 populations with the potential to provide permanent protection are monitored (or are expected to be monitored) on a regular basis. However, none of these populations currently show a steadily increasing trend over a period of five years.

Habitat for the species continues to become increasingly fragmented with the rapid urbanization of the Charlotte, NC metropolitan area. The greater Charlotte-Gastonia-Concord area of North and South Carolina was identified as one of 35 fastest growing large metropolitan areas in the country in a recent report examining the effects of sprawl upon endangered species (Ewing et al. 2005). For these reasons, this plant continues to meet the definition of an endangered species under the ESA.

III. RESULTS

A. Recommended Classification:

__x__ No change is needed

B. New Recovery Priority Number:

2C (FY 2009 Recovery Data Call), corresponding to "high" magnitude of threat, "high" recovery potential, taxonomic status of "species", and a potential for conflict with economic development. This number has been changed to reflect that recovery potential appears high due to the combined efforts of numerous partners who are actively working to acquire, manage, and monitor sites. An additional "c" has been added in recognition of the inherent threat to the species from economic development and associated road improvements, etc.

IV. RECOMMENDATIONS FOR FUTURE ACTIONS

- For sites with the potential to contribute toward the species' recovery (Appendix B, Tables B.1 and B.2), work with appropriate owners/managers to implement monitoring capable of producing reliable trend data at each site. Range-wide standardized monitoring protocol are generally not regarded as feasible for this species, due to the widely varying sizes of populations and the resources available to monitor them. However, site-specific protocol could be implemented such that counts or estimates provided at a given site are directly comparable from one monitoring period to the next.
- For sites with the potential to contribute toward the species' recovery (Appendix B, Tables B.1 and B.2), characterize existing vegetation using standardized community classification methods (e.g., NatureServe's community classification systems and Schafale and Weakley (1990)). Use this information to inform restoration objectives and direct future site protection efforts toward the highest quality habitats.
- Devise recovery criteria which balance the availability of suitable habitat with opportunities for restoration, management, and protection as dictated by landowner willingness and resource availability. These criteria should emphasize the role of prescribed fire in site restoration and management, but allow for those instances in which sites cannot be managed with fire.
- Work with Dr. Richard Houk (Winthrop University, retired) to find successors to continue his monitoring efforts in South Carolina.
- Clarify the role of controlled propagation, rescue and relocation, and public demonstration gardens in the species' recovery, so that sites supporting native populations in conjunction with remnants of native plant communities are prioritized for protection (above sites characterized by rescued and introduced plant material).

V. REFERENCES

Barden, L. 2000. Demography of an Endangered sunflower: *Helianthus schweinitzii*. Mineral Springs and Gar Creek Preserve, Union and Mecklenburg Counties, North Carolina. 1992-1999. Research accomplished under a UNCC Faculty Summer Research Grant. Report submitted to the Graduate School, UNC-Charlotte. June 30, 2000.

Barden, Lawrence (Larry). 2010. University of North Carolina at Charlotte. Personal communication to Carolyn Wells, U.S. Fish and Wildlife Service. Emails dated May 5 and 6, 2010.

Bates, M. 2003. Status Survey and Protection Prioritization of Schweinitz's sunflower (*Helianthus schweinitzii*) [North Carolina sites only]. Prepared for the U.S. Fish and Wildlife Service, Cooperative Agreement No. 1448-40181-02-J-034. 16 pp. plus Appendices. February 15, 2003.

Ewing, R., J. Kostyack, D. Chen, B. Stein, and M. Ernst. 2005. Endangered by Sprawl: How Runaway Development Threatens America's Wildlife. National Wildlife Federation, Smart Growth America, and NatureServe. Washington, D.C. January 2005.

Frazer, Mary. 2010. North Carolina Department of Transportation. Personal communication with Carolyn Wells, U.S. Fish and Wildlife Service, Asheville, North Carolina.

Houk, D. 2003. Status Survey and Protection Prioritization of Schweinitz's sunflower (*Helianthus schweinitzii*) in York and Lancaster Counties, South Carolina. Prepared for the U.S. Fish and Wildlife Service, Cooperative Agreement No. 1448-40181-02-J-032. 30 pp. July 2003.

Matthews, C.R. and Howard, J.H. 1999. Genetic Variation in the Federally Endangered Schweintz's Sunflower, *Helianthus schweinitzii* T. & G. (Asteraceae). Castanea: 64 (3): 231.

NatureServe, 2004. A Habitat-based Strategy for Delimiting Plant Element Occurrences: Guidance from the 2004 Working Group. A full copy of this guidance is available at: http://www.natureserve.org/library/deliminting_plant_eos_Oct_2004.pdf.

North Carolina Natural Heritage Program (NC NHP), 2006. Element Occurrence Records for *Helianthus schweinitzii*. Print date:March 29, 2006.

Savin (now Mason), Suzanne. 2003. Microsatellite analysis of seven populations of *Helianthus schweinitzii*. Research proposal synopsis provided to U.S. Fish and Wildlife Service, January 2003.

Savin, Suzanne. 2006. North Carolina Natural Heritage Program. Personal communication to Carolyn Wells, U.S. Fish and Wildlife Service.

Schafale, M. and A. Weakley. 1990. Classification of the Natural Communities of North Carolina, 3rd Approximation. Publication of the North Carolina Natural Heritage Program. Available at http://www.ncnhp.org/Pages/publications.html.

U.S. Fish and Wildlife Service. 1991. Schweinitz's sunflower (*Helianthus schweinitzii*) determined to be endangered. Federal Register 56: 21087 – 21091.

U.S. Fish and Wildlife Service. 1994. Recovery Plan for Schweinitz's sunflower (*Helianthus schweinitzii*). Dated April 22, 1994.

Weakley, Alan S. 2006. Flora of the Carolinas, Virginia, Georgia and surrounding areas. University of North Carolina Herbarium. Working Draft as of January 2006.

U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW of *Helianthus schweinitzii*

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

____ **Downlist to Threatened**
____ **Uplist to Endangered**
____ **Delist**
__x__ **No change is needed**

Appropriate Listing/Reclassification Priority Number, if applicable _____

Review Conducted By: Carolyn Wells

FIELD OFFICE APPROVAL:

Lead Field Supervisor, Fish and Wildlife Service

Approve _____ Date 5/18/10

REGIONAL OFFICE APPROVAL:

Acting
Lead Regional Director, Fish and Wildlife Service

Approve _____ Date 8-24-10

Appendix A: Peer Review

Summary of peer review for the five-year review of Schweinitz's sunflower (*Helianthus schweinitzii*).

A. Peer Review Method: The Service circulated this review to various individuals with extensive expertise with Schweinitz's sunflower. These individuals included staff of the Service's Raleigh Field Office and Sand Hills sub-office, the North Carolina Natural Heritage Program, the North Carolina Plant Conservation Program, the North Carolina Department of Transportation, the U.S. Forest Service, and Mecklenburg County Parks and Recreation.

B. Peer Review Charge: Peer reviewers were asked to conduct a scientific review of technical information presented. Reviewers were not asked to review the legal status determination.

C. Summary of Peer Review Comments: The majority of comments pertained to the size and/or protection status of particular subpopulations. Reviewers typically did not comment on the narrative content of the review itself, with the exception of one reviewer that provided editorial (typographical) comments.

D. Response to Peer Review: All updated information was incorporated into Appendix B (Tables B.1 and B.2), as the Service had no reason to dispute the updated information. Editorial comments and requests for clarification in the text were incorporated where appropriate.

Appendix B: Tables

Table B.1: North Carolina populations of *Helianthus schweinitzii* with a potential to contribute to the recovery of the species.

Table B.2: All known South Carolina populations of *Helianthus schweinitzii*, grouped into eight distribution centers as recognized in a recent status survey (Houk 2003).

Table B.1 North Carolina populations of *Helianthus schweinitzii* with a potential to contribute to the recovery of the species. Populations are shaded in light gray, followed by subpopulations (not shaded). [1]

Landscape/project	County	NHP EO number [2]	Owner/ Manager[3]	Mgmt plan	Mgmt Initiated	Native, Introduced, Augmented[4]	Monitored	Trend[5]	Latest size estimate (year)
Uwharrie NF: NC 109	**Montgomery**	**44.000**	**Y**	**In prep**	**N**	**Native**	**Y**	**Unknown**	
US NC 109		44.000	USFS	in prep	N	N	Y	stable?	150 stems (2005)
Uwharrie NF: Badin and Machine Branch	**Montgomery**	**110.000**	**Y**	**In prep**	**N**	**Native**	**N**	**Unknown**	
Badin Area: Falls Dam		110.015	USFS	in prep	N	N	informally	unknown	100-200 stems (2006)
Forest Service Road 576		110.024	USFS	in prep	N	N	informally	unknown/stable?	201 stems (2002)
Trail to Falls Dam		110.025	USFS	in prep	N	N	informally	decreasing	2 clumps (1995)
Trail to Falls Dam		110.192	USFS	in prep	N	N	informally	decreasing	3 stems (2006)
Forest Service Road 576		110.193	USFS	in prep	N	N	informally	unknown/ extirpated?	None
Forest Service Road 576		110.194	USFS	in prep	N	N	informally	unknown/ extirpated?	None
Forest Service Road 576		110.195	USFS	in prep	N	N	informally	unknown	> 200 stems (2006)
Uwharrie NF: Roberdo south	**Montgomery**	**111.000**	**Y (in part)**	**In prep**	**N**	**Native**	**N**	**Unknown**	
RR and NC 109 north		111.028	USFS (in part)	in prep	N	N	informally	declining	5 stems (2006)
Bruton-Carpenter Road		111.036	USFS (in part)		N	N	informally	decreasing	40 stems (2006)
Roberdo, LeGrand		111.043	USFS	N	N	N	N	extirpated?	1 plant (?)
W Montgomery HS at NC 109		111.061	USFS	in prep	N	N	informally	increasing	317 stems (2006)
W Montgomery HS at powerline		111.067	USFS	in prep	N	N	informally	decreasing	29 stems (2006)

Table B.1, continued.

Landscape/project	County	NHP EO number [2]	Owner/ Manager[3]	Mgmt Plan	Mgmt Initiated	Native, Introduced, Augmented[4]	Monitored	Trend[5]	Latest size estimate (year)
Uwharrie NF: Roberdo south	**Montgomery**	**111.000**	**Y (in part)**	**In prep**	**N**	**Native**	**N**	**Unknown**	
Kiesler tract and vicinity		111.068	PRV	Y	Y?	N	informally	increasing	581 stems (2006)
NC 24/27		111.069	USFS	in prep	n/a	N	informally	stable?	104 stems (2006)
NC 109 S of 24/27		111.204	USFS	in prep					
NC 109 S of 24/27		111.205	USFS	in prep					
RR Track S of McLeod Rd		111.206	USFS	in prep	N				
RR Track S of McLeod Rd		111.207	USFS	in prep	N				
Uwharrie NF: Roberdo north	**Montgomery**	**181.000**	**Y**	**In part**	**In part**	**Various**	**In part**	**Varied**	
Roy Cooman's RR site		181.027	USFS	in prep	N	N	informally	Increasing	408 stems (2006)
Boon Chesson's		181.122	PRV	Y	Y	I	Y	decreasing	< 100 stems (2006)
Uwharrie NF: Morris Mountain	**Montgomery**	**145.000**	**Y**	**In prep**		**Native**	**Y**	**Stable**	
Morris Mountain		145.000	USFS	in prep	n/a	N	informally	stable	41 stems (2006)
Uwharrie NF: Rabbit Mountain	**Montgomery**	**146.000**	**Y**	**In prep**		**Native**	**Y**	**Stable**	
SR 1146 Mountain		146.000	USFS	in prep	n/a	N	informally	Stable	146 stems (2006)
Uwharrie NF: Walker Mountain	**Montgomery**	**178.000**	**Y**	**In prep**		**Native**	**Y**	**Declining**	
Wood Run Camp (FSR 51)		178.118	USFS	in prep	n/a	N	informally	declining	7 stems (2006)
Wood Run Camp 2		*178.176*	USFS	*N*	*n/a*		*n*	*misidentified?*	*2 stems (2002)*

Table B.1, continued.

Landscape/project	County	NHP EO number [2]	Owner/ Manager[3]	Mgmt Plan	Mgmt Initiated	Native, Introduced, Augmented[4]	Monitored	Trend[5]	Latest size estimate (year)
Uwharrie NF: Barnes Creek/ Poison Fork	**Montgomery /Randolph**	**148.000**	**In part**	**In part**	**In part**	**Various**	**In part**	**Unknown**	
Harvest Field Baptist Church		148.056	NCPCP (in part)	in prep	N	N	informally	unknown	
Thompson tract		148.066	PRV	N	N	N	Y	increasing?	500-1000 stems (2006)
Bennett tract		148.071	PRV	Y	Y	N	Y	increasing	400-700 stems (2006)
Walkers Creek Forests		148.129	USFS (in part)	in prep	N	N + I?	informally	unknown	
Wysner Mountain		148.198	PRV	Y	Y	I	Y	increasing	1,170 stems (2006)
Okewemee Woodland	**Montgomery**	**141.000**	**Y**	**Y**	**Y**	**Various**	**Y**	**Stable/increasing?**	
Okewemee Woodland		141.143	NCPCP	Y	Y	N	Y	stable/increasing?	> 500 stems (1999, RR only)
Okewemee Woodland – interior		141.211	NCPCP	Y	Y				
Okewemee Woodland – interior		141.212	NCPCP	Y	Y				
Caraway Mountain	**Randolph**	**201.00**	**Y**	**Y**	**Y**	**Various**	**Y**	**Declining?**	
Caraway Mountain - roadside		201.029	NC Zoo (in part)	Y	Y	N	Y	increasing	1,190 stems (2002)
Caraway Mountain NC Zoo		201.200	NC Zoo	Y	Y	U			
Caraway Mountain NCDOT		201.223	NCDOT	Y	Y	I	Y	unknown	651 stems (2008)
Purgatory Mountain	**Randolph**	**179.000**	**Y**	**Y**	**Y**	**Introduced**	**Y**	**Unknown**	
Purgatory Mountain		179.000	NC Zoo	Y	Y	I	Y	unknown	331 pots, ea. w/4-5seedlings (1997)

Table B.1, continued.

Landscape/project	County	NHP EO number [2]	Owner/ Manager[3]	Mgmt Plan	Mgmt Initiated	Native, Introduced, Augmented[4]	Monitored	Trend[5]	Latest size estimate (year)
Shuffletown Prairie/ Mountain Island Lake Dam	**Mecklenburg**	**89.000**	**In part**	**In part**	**In part**	**Various**	**Y**	**Increasing**	
Mountain Island Lake Dam		89.032	PRV	N	n/a	N	Y?	increasing	> 1000 flw stems (2002)
Shuffletown Prairie		89.051	County Parks and Rec.	Y	Y	N+I	Y	increasing	2131 stems (2006)
Latta Prairie/McCoy Road/Gar Creek	**Mecklenburg**	**92.000**	**Y**	**Y**	**Y**	**Various**	**Y**	**Stable**	
McCoy Road (Gar Creek Preserve)		92.017	County Parks and Rec.	Y	Y	N	Y	stable	1310 flw stems (2005)
Latta Plantation		92.139	County Parks and Rec.	Y	Y	I	Y	stable	545 flw stems (2005)
McDowell Preserve and vicinity	**Mecklenburg**	**138.000**	**Y**	**In part**	**Y**	**Various**	**Y**	**Varied**	
Winget Road		138.030	County Parks and Rec.	Y	Y	N	Y	stable	334 stems (2006)
Island Point (Shopton)		138.137	County Parks and Rec.	N		N+I	Y	declining?	> 1000 stems (2006)
McDowell Prairie		138.140	County Parks and Rec.	Y	Y	I	Y	declining	1797 stems (2005)
Mineral Springs and vicinity	**Union**	**112.000**	**Y**	**Y**	**Y**	**Native**	**Y**	**Declining?**	
Mineral Springs Barren		112.013	NCPCP	Y	Y	N	Y	declining?	534 stems (2002)
Redlair Preserve	**Gaston**	**95.000**	**Y**	**In prep**	**Y**	**Native**	**Y**	**Increasing**	
Rankin tract		95.000	PRV	in prep	Y	N	Y	increasing	2,189 stems (2005)
Hanging Rock State Park and vicinity	**Stokes**	**99.000**	**Y**	**Y**	**Y**	**Introduced**	**Y**	**Declining?**	
Lackey tract		99.000	PRV	Y	Y	I	Y	unknown	30 clumps (2006)

Table B.1, continued.

Landscape/project	County	NHP EO number [2]	Owner/ Manager[3]	Mgmt Plan	Mgmt Initiated	Native, Introduced, Augmented[4]	Monitored	Trend[5]	Latest size estimate (year)
Surratt Road	**Davidson**	**222..124**	**Y**	**In prep**	**Y**	**Native**	**Y**	**Stable?**	
Surratt Road - roadside		222.124	NCDOT	in prep	Y	N	Y	stable?	839 flw stems (2002)
Surratt Road – interior		222.221	NCDOT	Y					
Cane Creek Park	**Union**	**217.000**	**Y**	**In prep**	**Y**	**Introduced**	**Y**	**Increasing**	
Cane Creek Park		217.000	County Parks and Rec.	in prep	Y	I	Y	increasing?	5,993 stems (2009)
Terry Sharpe Tract	**Richmond**	**229.000**	**Y**	**Y**	**Y**	**Introduced**	**Y**	**Unknown**	
Sharpe Tract			PRV	Y	Y	I	Y	unknown	20 stems (2006)

[1] Principal Natural Heritage Program (NHP) Element Occurrence (EO) records (shaded in light gray) are herein regarded as proxies for populations of the species, whereas sub EOs (no shading) represent site-specific locations within each population where plants have been documented to occur. NOTE: This table only lists those populations (and subpopulations) that show prospect of contributing to the long-term recovery of the species.

[2] NHP Element Occurrence (EO) Numbers use the following format: PrincipalEO.Sub(or stand-alone)EO.

[3] Owner/manager abbreviations: NCDOT = North Carolina Department of Transportation; NC DPR = North Carolina Department of Parks and Recreation; NCPCP = North Carolina Plant Conservation Program; PRV = conserved private; USFS = U.S. Forest Service. No entry indicates sites not in protective ownership.

[4] "N" = native (no introduction or augmentation of plant material known to have occurred at any time in the past); "I" = introduced (plant material, either seeds, rootstock or both, was brought to this site from other location(s)), "A" = augmentation (an existing, native population was enhanced by seeds or rootstock either collected from elsewhere within the same site or from a different site). Combinations of these are possible, and are denoted as appropriate.

[5] Trends have been subjectively determined using counts or estimates, as available from the NC NHP database, and other sources (personal communication with species or site experts). A master spreadsheet containing these counts is on file with the Asheville ES Field Office. In the majority of cases, these trends have been inferred from fewer than five years of monitoring data, and there is some question as to the year-to-year comparability between counts/estimates.

Table B.2 South Carolina populations (shaded in light gray) and subpopulations (not shaded) of *Helianthus schweinitzii*. Data adapted from Houk (2003).

Landscape/project	County	NHP EO number	Site Protection	ROW	Mgmt Plan	Native, Introduced, Augmented	Threat	Recovery	Monitored	Trend	Stem count (2002)
Indian Land	**Lancaster**										
JimWilsonRd		037	n	y	n	N	Med	Low	y	Increasing	292
DaveLyleExtension/HelmsSide		New2001	recommended	y	n	N	Med	Med	y	Increasing	254
DaveLyleExtension/OsceolaSide		New2001	recommended	y	n	N	Med	Low	y	Unknown	365
AnderVincentRd		New2002	n	y	n	N	Med	Low	y	Unknown	185
LaneyRd		New2002	n	n	n	N	High	Low	y	Unknown	28
Rock Hill North	**York**										
Newport		026	n	n	n	N	High	Low	y	Decreasing	13
HandsMill/LittleAllisonCr		041	n	y	n	N	High	Low	y	Decreasing	23
HandsMill/AllisonAcres		043	n	n	n	N	High	Low	y	Stable	181
MtGallant/Homestead		042	n	y	n	N	High	Low	y	Decreasing	62
Rock Hill South	**York**										
AlbrightRd/Blackmon-Heckle		New1997	n	n	n	N	High	Low	y	Unknown	194
AlbrightRd/BlackmonRd		011	n	y	n	N	High	Low	y	Extirpated	0
AlbrightRd/Midvale-Rockdale		New1997	n	n	n	N	High	Low	y	Decreasing	69
AlbrightRd/Plazas hopping		016	n	y	n	N	High	Low	y	Decreasing	36
AlbrightRd/Rockdale-Blackmon		New1997	n	n	n	N	High	Low	y	Decreasing	84
AT&T/Archer to Porter Rd		015	n	y	n	N	Low	Low	y	Increasing	30
AT&T/Northway		012	n	y	n	N	Med	Low	y	Increasing	336
AT&T/Pearson to Sewer		013	n	y	n	N	Low	Low	y	Decreasing	96
AT&T/RockHillTelephone		005	n	y	n	N	High	Low	y	Stable?	103
AT&T/Rolling Ridge		004	n	y	n	N	High	Low	y	Increasing	120
BlackmonSt/CabinetWorks		039	n	n	n	N	High	Low	y	Increasing	498
Duke Power Line		003	n	y	n	N	Med	Low	y	Stable?	194
I-77Exit75/NorthboundOnRamp		New1995	recommended	y	n	N	Med	Med	y	Decreasing	227

Table B.2, continued.

Landscape/project	County	NHP EO number	Site Protection	ROW	Mgmt Plan	Native, Introduced, Augmented	Threat	Recovery	Monitored	Trend	Stem count (2002)
Rock Hill South (continued)	**York**										
I-77Exit75Northbound/SpoilPile		New2001	n	n	n	N	Med	Low	y	Increasing	198
Longmeadow		007	n	n	n	N	NA	NA	y	Extirpated	0
MartinMarietta/HawkfieldRd		020	n	y	n	N	High	Low	y	Stable?	70
PorterRd/Castlewood-Kinghurst		New1999	n	y	n	N	High	Low	y	Increasing	360
PorterRd/Hinsdale		022	n	y	n	N	High	Low	y	Increasing	168
PorterRd/I-77Mile75South		021	n	y	n	N	Med	Low	y	Decreasing	15
RHBlackjacks/AMP		New1996	y	n	y	I	NA	NA	y	Increasing	4561
RHBlackjacks/AT&T		014	y	y	y	N	Low	High	y	Increasing	2019
RHBlackjacks/PineWoods		019	y	n	y	N	Med	Low	y	Stable?	7
RHBlackjacks/SewerROW		017	y	y	y	N	Low	High	y	Increasing	253
RHBlackjacks/UtilityLineROW		018	y	y	y	N	Med	High	y	Increasing	192
Southland Park		006	n	y	n	N	Med	Low	y	Increasing	39
Rock Hill East	**York**										
RockHillRiverPark		New2001	recommended	y	n	I	High	Med	y	Increasing	267
Sturgis/WaterfordPrkwy		New2002	n	y	n	N	High	Low	y	Unknown	7
SpringsteenRd		New2001	n	n	n	N	High	Low	y	Extirpated	0
Rock Hill West	**York**										
Heckle/Hwy5		023	n	y	n	N	High	Low	y	Decreasing?	566
Heckle/HollisLakes		024	recommended	y	n	N	Med	Med	y	Increasing	1021
HollisLake/ConcretePlant		025	n	y	n	N	High	Low	y	Increasing	525
HollisLake/Olewoods		New2001	n	y	n	N	High	Low	y	Increasing	405
Herlong/Eastover		044	n	y	n	N	High	Low	y	Extirpated	0
Heckle/WagonWheel		New2002	recommended	y	n	N	Med	Med	y	Unknown	125
Olewoods/Utility		New2001	n	y	n	N	High	Low	y	Increasing	405

Table B.2, continued.

Landscape/project	County	NHP EO number	Site Protection	ROW	Mgmt Plan	Native, Introduced, Augmented	Threat	Recovery	Monitored	Trend	Stem count (2002)
Fort Mill South	**York**										
Old US21Road		010	n	y	n	N	High	Low	y	Decreasing?	238
US 21BYP ROW		027	n	y	n	N	Med	Low	y	Increasing	638
TruckStopField		028	n	n	n	N	High	Low	y	Decreasing	5
SuttonRd/I-77		029	n	y	n	N	High	Low	y	Increasing	116
Spratt St		030	n	y	n	N	Med	Low	y	Stable?	178
BrickyardRd/RadioTowerRd		031	n	y	n	N	High	Low	y	Stable?	10
BrickyardRd/RadioTower-Church		New2000	n	y	n	N	Med	Low	y	Increasing	81
BrickyardRd/Church		009	n	y	n	N	High	Low	y	Increasing	105
BanksRd/BrickyardRd		032	n	y	n	N	High	Low	y	Increasing	765
BanksRD/DukeTransmission		033	y	y	y	N+A	Low	High	y	Increasing	5680
I-77/Duke Transmission/SCDOT		040	y	y	n	N	Low	High	y	Stable?	43
I77/DukeTransmission/JScottProp.		New2001	n	y	n	N	Med	Med	y	Increasing	99
McColl/Museum/ TransTowers52-53		New1996	recommended	y	n	N	Med	Med	y	Unknown	1715
McColl/Museum/MuseumBluff		New1999	n	y	n	N	High	Low	y	Unknown	1665
McColl/Museum/DistributionROW		New1999	n	y	n	N	Med	Low	y	Unknown	189
BanksRd/PleasantRidge		008	n	y	n	N	High	Low	y	Increasing	214
FtMillParkway		New2002	n	y	n	N	Med	Low	y	Unknown	7
Fort Mill North	**York**										
US21BYP/GoldHillRd		036a	n	y	n	N	Med	Low	y	Stable?	156
GoldHillRd/US21BYP-SteeleCr.		035	n	y	n	N	High	Low	y	Extirpated?	0
SC160/PleasantRd		038a	n	y	n	N	NA	NA	y	Extirpated	0
McManusRd		038b	n	y	n	N	Med	Low	y	Unknown	1242
Gardendale		New2002	n	y	n	N	Med	Low	y	Unknown	159
ASCGPrairieRestorationSite I		New1997	y	n	y	I	Low	Med	y	Extirpated	0
ASCGPrairieRestorationSite II		New1997	y	n	n	I	Low	Med	y	Decreasing	57

Table B.2, continued.

Landscape/project	County	NHP EO number	Site Protection	ROW	Mgmt Plan	Native, Introduced, Augmented	Threat	Recovery	Monitored	Trend	Stem count (2002)
Brattonsville	**York**										
BrattonsvillePrairie		New2001	y	n	y?	I	Low	High	y	Increasing	315

5-YEAR REVIEW OF SCHWEINITZ'S SUNFLOWER (*Helianthus schweinitzii*)

Addendum 1. Summary of new information obtained since the 2010 5-year review.

The *Federal Register* notice announcing the initiation of this 5-year review was published on August 6, 2018 (83 FR 38320). No comments were received during the 60-day public comment period following this notice. However, the U.S. Fish and Wildlife Service (Service) did receive additional information about the species, from biologists familiar with the species, in response to requests for specific information.

Updated information is presented below. Internal review was conducted by three members of the Service's South Atlantic-Gulf Region. Additionally, the Service conducted independent peer review of new information (Appendix A). The Service sought review from eight knowledgeable experts on this species and its habitats. Comments have been addressed and incorporated into this addendum as appropriate and necessary.

I. GENERAL INFORMATION

B. Reviewers

Lead Field Office: Asheville Ecological Services, Rebekah Reid, (828) 258-3939.

Cooperating Field Offices: South Carolina Ecological Services, April Punsalan, (843) 727-4707; and Raleigh Ecological Services, Dale Suiter, (919) 856-4520.

C. Background

1. **Federal Register Notice citation announcing initiation of this review:** 83 FR 38320; August 6, 2018.

2. **Species Status:** Inconsistent and infrequent monitoring increases uncertainties associated with the species' status and trends; however, available data suggest that sites with some potential to provide a role in recovery collectively contain over 50,000 stems, an increase from over 40,000 stems in 2010 (North Carolina Natural Heritage Program (NCNHP) 2018; South Carolina Heritage Trust Program (SCHTP) 2017; Service 2010). Population trends for each protected population and sub-population are identified in Appendix B and discussed in detail in Sections II.B.3 and II.C.1a. Status trends for populations with potential to provide a role in recovery are: 10 increasing, four stable, nine decreasing, and one of unknown status. Five populations in North Carolina (NC) (representing four counties) and possibly one population in South Carolina (SC) (representing one county) are currently of good to excellent viability (NCNHP 2018, SCHTP 2017).

6. **Review History:** The Service finalized a 5-year review for Schweinitz's sunflower (*Helianthus schweinitzii*) in 2010. The review recommended the species remain classified as endangered due to fragmented habitat, increased urbanization, and lack of increasing status trend (Service 2010). Each year, the Service reviews and updates listed species information for inclusion in the required Recovery Report to Congress. Through 2013, the Service did a recovery data call that included status recommendations for this species. We continue to show this species' status recommendation as part of our 5-year reviews. The last review for this species to inform the Recovery Report to Congress was conducted in 2019.

II. REVIEW ANALYSIS

B. Recovery Criteria

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

Schweinitz's sunflower will be considered for reclassification from endangered to threatened when 10 geographically distinct, self-sustaining populations are protected in at least four counties in North Carolina and one in South Carolina; managers have been designated for each population; management plans have been developed and implemented; and populations have been maintained for five years (Service 1994).

<u>10 geographically distinct, self-sustaining populations are protected in at least four counties in North Carolina and one in South Carolina</u>

To evaluate this criterion, protection status was evaluated first followed by self-sustainability of the protected populations. Species data from the NCNHP and the SCHTP was evaluated for population presence and protection status (NCNHP 2018, SCHTP 2017). It was determined that there are 24 geographically distinct populations or portions of populations, 20 in NC and four in SC, in protective ownership (public or conservation organization ownership) with the potential to meet the recovery criteria developed for Schweinitz's sunflower (Appendix B). Although the number of populations identified is the same as in the 2010 5-year review, populations and sub-populations have been added or removed from Appendix B based on updated data. Populations and sub-populations were removed if they were identified as extirpated or "failed to find", had no protection status, or plants where relocated to a different site; additions include those populations or sub-populations that gained protection since the last 5-year review or were newly identified on protected property. Protected populations are located in: Davidson, Gaston, Mecklenburg, Montgomery, Randolph, Richmond, Stokes, and Union Counties in NC and York County in SC. Partners in conservation include: the U.S. Forest Service (USFS), Mecklenburg County Parks and Recreation, NC Plant Conservation Program (NCPCP), NC Department of Transportation (NCDOT), land trusts, NC Wildlife Resources Commission (NCWRC), NC Zoo, Hanging Rock State Park, SC Department of Environment and Natural Resources (SCDNR), and SC Department of Transportation.

Twelve of the 20 populations in NC are entirely protected, including all sub-populations (representing six counties), by either public lands or conservation organization ownership. Of those 12 populations, five populations, representing four counties, have a NCNHP Element Occurrence (EO) rank of A (excellent viability) or B (good viability) (NCNHP 2018). EO ranks provide a succinct assessment of the estimated viability of occurrences of a given species. They provide an estimation of the likelihood that, if current conditions prevail, a species occurrence will persist for a period of time. A-ranked (excellent viability) and B-ranked (good viability) populations exhibit optimal or favorable characteristics with respect to population size and/or quality and quantity of occupied habitat; and, if current conditions prevail, the occurrence is very likely to persist into the future. These occurrences have characteristics that make them relatively invulnerable to extirpation or sustained population declines, and they are expected to persist in current or better condition (Hammerson et al. 2008).

One of four populations in SC is entirely protected (representing one county). The one SC population has an EO rank of BC (good-fair viability) (SCHTP 2017). Range ranks are used to indicate uncertainty when assigning the EO rank and when further information is needed to determine the degree of viability (NatureServe n.d.). BC-ranked populations are deemed to have a good to fair probability of persisting, if current conditions prevail, for a defined period of time (NatureServe n.d).

There are five populations in NC (representing four counties) and possibly one in SC (representing one county) with good to excellent viability. While viability does not equate to long-term self-sustainability, it is an indicator of population status and probability of persistence if current conditions prevail. Current conditions at protected sites are a result of active management, and if current management regimes continue, these populations are likely to persist into the future. These populations (six) have been assumed to meet this recovery criteria; although, they are not "self-sustaining" because of the need for consistent management.

The definition and/or criteria of self-sustainability should be reevaluated for this species to clarify the definition as it relates to this species. Conventional definitions of self-sustainability that include maintaining by independent effort or lack of external support will rarely, if ever, apply to Schweinitz's sunflower due to required on-going management to maintain suitable habitat conditions. Success of highly viable populations is dependent on active management.

<u>Managers have been designated for each population; and management plans have been developed and implemented</u>

All 24 populations identified above are, at least partially, owned by or under conservation easement with natural resource agencies, conservation organizations, or other entities dedicated to conservation. Although official designation of a manager may not have occurred at each protected population or sub-population, the owners/responsible parties listed in Appendix B are dedicated to the conservation of Schweinitz's sunflower at their sites. Twenty-three populations have finalized management plans that include all protected sub-populations. Three sub-populations, in one population, lack a finalized management plan;

however, a plan encompassing two sub-populations is in preparation and the site has been successfully managed for years without a finalized plan (Starke 2019, NC Plant Conservation Program (NCPCP) pers. comm.). Management has been implemented, to varying degrees, at all protected sub-populations in 20 populations and three of five protected sub-populations in another population (21 populations with, at least partial, management) (Appendix B).

Management plans vary in specificity and complexity, and implementation of management is limited by resource availability. Although management plans have been developed and implemented at a majority of the 24 populations (Appendix B), the populations are often comprised of multiple sub-populations with varying ownership and protection status; therefore, only 13 of the 24 populations are entirely in protective ownership with management (representing six counties in NC and one county in SC).

Populations have been maintained for 5 years

The NCNHP has mapped the 20 NC populations identified above as eight stand-alone EOs and 12 principal EOs with 33 sub-EOs. For this species in NC, principle EOs represent an entire population and can contain multiple sub-EOs (a smaller geographically distinct area contained within a principle EO). A stand-alone EO contains one occurrence, representing a population, with no sub-EOs. Principle and stand-alone EOs can be thought of as proxies for populations and sub-EOs as proxies for sub-populations in the absence of species-specific information on pollination and dispersal distances. Population trends for each protected stand-alone and sub-EO are identified in Appendix B. Sub-EOs were evaluated together to determine the overall status of a principle EO.

The SCHTP has not assigned EOs to all known sites and has not aggregated EOs into stand-alone and principal/sub-EOs. Instead, the Service recognizes eight geographically distinct areas (comprised of multiple EOs and unassigned sites), defined by Houk (2003), which approximate populations in SC (Service 2010). Six EOs and two unassigned sites, identified in Appendix B, are included in four of the eight populations identified by Houk.

Status trends for all 24 populations are summarized below and, in many cases, the trend could be evaluated beyond five years.

Table 1. Summary of Population Trends in NC and SC.

Status Trend	Number of Populations
Increasing	10
Stable	4
Decreasing	9
Unknown Status	1
Total	24

The five populations in NC (representing four counties), identified previously with an A or B-rank, are included in the table above and have the following status trends: two increasing, one decreasing, and two stable.

The one population in SC (representing one county), identified previously with a BC-rank, has an increasing status trend. Plants continue to be introduced to this population and it is unknown if the site is experiencing a true increase or an inflated increase due to continued introductions.

Summary

Although management plans have been developed and implemented at a majority of the 24 populations and at least 13 populations have stable or increasing status trends; inherently, recovery criteria, as defined above, have not been met since the preceding criteria, requiring 10 geographically distinct, self-sustaining populations, has not been met. As described above, only six populations meet this criteria. Additionally, as similarly described in the 2010 5-year review (Service 2010), the species range has expanded to include 17 counties in NC and SC, and meeting current recovery criteria would not include representation throughout the species range.

Delisting the species will be considered when at least 15 geographically distinct, self-sustaining populations are protected in at least four counties in NC and one county in SC; management plans have been implemented; populations (as measured by number of adult plants) have been stable or increasing for 10 years; and permanent conservation ownership and management of at least 10 populations is assured by legally binding instrument.

These criteria are not discussed further because they are the same or stricter than the criteria for reclassification to threatened, which are discussed above and have not been met.

C. Updated Information and Current Species Status

1. Biology and Habitat

a. Abundance, population trends (e.g., increasing, decreasing, stable), demographic features (e.g., age structure, sex ratio, family size, birth rate, age at mortality, mortality rate, etc.), or demographic trends: When the species was federally-listed in 1991, there were a total of 13 extant populations (eight in NC and five in SC) (Service 1991). The 1991 listing rule did not indicate the number of plants within the 13 populations; however, supporting information suggests that these sites collectively contained approximately 2,805 stems (Service 2010).

At the time of the 2010 5-year review, there were 165 EO records in the NCNHP database (Service 2010). The EOs aggregated into 78 populations. In SC, there were eight geographically distinct areas, which approximate populations (Houk 2003). Therefore, the known range consisted of 86 populations, 78 in NC and eight in SC. Available data suggested that sites with some potential to provide a role in recovery collectively contained over 40,000 stems (Service 2010).

As of 2018, there are 217 EO records (including 15 extirpated records) in the NCNHP database (NCNHP 2018). The EOs aggregate into 81 extant populations using the NatureServe EO mapping standards for plants (NatureServe 2004). There are 79 EO

records (including three extirpated records) in the SCHTP database (SCHTP 2017). The EOs aggregate into the eight extant populations defined by Houk (2003) and one additional population that is located outside of Houk's population delineation. Therefore, the known range now consists of 90 populations, 81 in NC and nine in SC. Available data suggests that sites with some potential to provide a role in recovery collectively contain over 50,000 stems (NCNHP 2018; SCHTP 2017). A summary of extant populations is below.

Table 2. Population Summary.

	Number of Extant Populations		
Year	**NC**	**SC**	**Total**
1991	8	5	13
2010	78	8	86
2018	81	9	90

Trends for populations (principle or stand-alone EOs) and sub-populations (sub-EOs) with potential to meet the recovery criteria are discussed in Section II.B.3 and shown in Appendix B. The NCNHP has mapped the 20 NC populations identified in Section II.B.3 as eight stand-alone EOs and 12 principal EOs with 33 sub-EOs. The Service recognizes Houk's (2003) delineation of populations in SC and identified four populations in Section II.B.3. Forty-nine EOs are within the 24 populations, 41 in NC and eight in SC. Five EOs in SC are from one site and are not tracked separately. For the purposes of this review, those five EOs are treated as one, for a total of 45 EOs. Of the 45 EOs in NC and SC, 16 are increasing, seven are stable, 17 are decreasing, and five have an unknown trend. Fifty-one percent of EOs are increasing (36%) or stable (16%) and 38% of the EOs are decreasing. A summary of EO status is below.

Table 3. Summary of EO Status.

Status	Number of EOs	Percentage*
Increasing	16	36%
Stable	7	16%
Decreasing	17	38%
Unknown	5	10%
Total	45	100%

*percentages are approximate due to rounding.

Of the 41 EOs in NC, 32% have an EO rank of B or higher (excellent to good viability) and 66% have an EO rank of C or lower (fair to poor viability). In NC, with only one exception, the ranks in A and B-ranked populations are driven by introduced or augmented populations (NCNHP 2018). Due to the uncertainty assumed in the SC data, the same analysis of EO ranks could not be completed.

Additional EOs, not identified in Appendix B, are also monitored and represent trends throughout the range in populations and sub-populations that do not currently have the potential to meet recovery criteria. NCDOT personnel monitored roadside EOs of Schweinitz's sunflower in NCDOT Divisions 7-12 in 2017 and 2018 (Frazer 2018a,

Three Oaks, pers. comm.). Ninety-four EOs, representing 51 populations, whole or in part, were monitored. Of the 94 EOs, 28 are increasing, five are stable, 35 are decreasing, 16 are confirmed extirpated or could not be found, eight have an unknown trend, and two sites were newly identified (no EO number or rank assigned). Thirty-five percent of the monitored EOs were increasing (30%) or stable (5%) and 54% of EOs were decreasing (37%) or extirpated/not found (17%). A summary of EO status is below.

Table 4. Summary of EO Status.

Status	Number of EOs	Percentage*
Increasing	28	30%
Stable	5	5%
Decreasing	35	37%
Extirpated/ Not Found	16	17%
Unknown	8	9%
New	2	2%
Total	94	100%

*percentages are approximate due to rounding.

Of extant EOs monitored by NCDOT, 95% have an EO rank of C or less (fair to poor viability) indicating non-optimal occurrence characteristics and/or high risk of extirpation (Hammerson et al. 2008).

b. Genetics, genetic variation, or trends in genetic variation (e.g. loss of genetic variation, genetic drift, inbreeding, etc.): The Service is not aware of any genetic research (including genetic variation within or among populations) conducted for this species since the 2010 5-year review. After observing intermediate species morphology during field visits, species experts have questioned whether Schweinitz's sunflower hybridizes with other *Helianthus* species. Visits to at least five EOs, as identified in the heritage data, had observers speculate that hybrids are present (NCNHP 2018). Further research is needed to determine if the species is hybridizing and to what extent.

c. Taxonomic classification or changes in nomenclature: The Service is not aware of any changes in taxonomic classification or nomenclature since the 2010 5-year review.

d. Spatial distribution, trends in spatial distribution (e.g., increasingly fragmented, increased numbers of corridors, etc.), or historical range (e.g., corrections to the historical range, change in distribution of the species within its historical range, etc.): The 1991 listing rule identified the species range as including five NC counties (Cabarrus, Mecklenburg, Rowan, Stanly, and Union) and one SC county (York). The 2010 5-year review identified nine additional counties within the species range, eight in NC (Anson, Davidson, Gaston, Montgomery, Randolph, Richmond, Stokes, and Surry) and one in SC (Lancaster). New populations, constituting new county records, were identified in Catawba County, NC in 2011 (NCNHP 2018) and Guilford County, NC in 2018 (Frazer 2018b, Three Oaks, pers. comm.). The current species range includes 15 NC counties and two SC counties. A summary of the number of counties with extant populations is below.

Table 5. County Summary.

	Number of Counties with Extant Populations		
Year	**NC**	**SC**	**Total**
1991	5	1	7
2010	13	2	15
2018	15	2	17

e. Habitat or ecosystem conditions (e.g., amount, distribution, and suitability of the habitat or ecosystem): Smith (2008) examined the influence of several biotic and abiotic variables on the spatial distribution of Schweinitz's sunflower including soil, soil properties, elevation, aspect, and proximity to water (streams and rivers) and linear transport (roads and railroads). Sixty-nine percent of Schweinitz's sunflower EOs evaluated are found in ultisols. Ultisols are intensely weathered soils in warm and humid climates. They are acidic and lack calcium, potassium, and sufficient levels of phosphorus (bases). Over 52% of Schweinitz's sunflower EOs evaluated occur in the Tatum and Herndon soil types, both ultisols, and over 20% occur in the Goldston soil type, an inceptisol. Inceptisols are often found on fairly steep slopes, young geomorphic surfaces, and on resistant parent materials, most noticeably in the mountainous regions of NC. Over 72% of the Schweinitz's sunflower EOs evaluated are found in the three soil types identified above. Schweinitz's sunflower site soils were classified as sandy loam, sandy clay, silt loam, or loam. While silt percentage did not significantly differ between sites with Schweinitz's sunflower present, sand and clay percentages did significantly differ. The mean elevation for Schweinitz's sunflower EOs evaluated is approximately 651 feet and 79% of EOs had an easterly, southeasterly, or southerly aspect. The mean distance to a road or railroad is 55.8 meters (m) and 4,245.3m, respectively. The proximity to water (streams and rivers) was not significant, when compared to random points, and is not reported here.

Smith (2008) used a logistic regression analysis to relate attributes to EOs. The following characteristics increase or decrease likelihood of finding a Schweinitz's sunflower EO when compared to a random location:

- A location in a non-ultisol (specifically, an alfisol or inceptisol) decreases the likelihood of finding an EO by 71.2%
- A soil type of Tatum, Goldston, or Herndon increases the likelihood of finding an EO by 720.5%
- A southeasterly or southerly aspect increases the likelihood of finding an EO by 200.5%
- An increase of 1m in distance to a road decreases the likelihood of finding an EO by 0.7%

In the 45 EOs (in 24 populations) identified as having the potential to meet recovery criteria, 36% (16 EOs) are completely within a utility line or road right-of-way (ROW),

40% (18 EOs) are not within at ROW, and 24% (11 EOs) contain portions of the EO within and outside of a ROW (NCNHP 2018; SCHTP 2017).

f. Other relevant information about the species: No additional information beyond that already presented.

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

a. Present or threatened destruction, modification or curtailment of its habitat or range: The 1991 listing rule described the following threats to extant populations: loss of historic levels of natural disturbance from fire and grazing by native herbivores, residential and industrial development, mining, encroachment by invasive species, highway construction and improvement, utility ROW maintenance, and herbicide use. These threats remain present throughout the species range.

In the 45 EOs (in 24 populations) identified as having the potential to meet recovery criteria, 24% had one or more noted threat in the heritage data despite protection status and active management. Threats identified and the number of EOs impacted are summarized below.

Table 6. Threats and Number of EOs Impacted.

Threat	No. of EOs Impacted*
Herbicide	4
Invasives	2
Mowing (wrong season or excessive)	1
Native Competition	1
Other	2
Road Construction	1
Utility Construction	1
Woody Succession	4

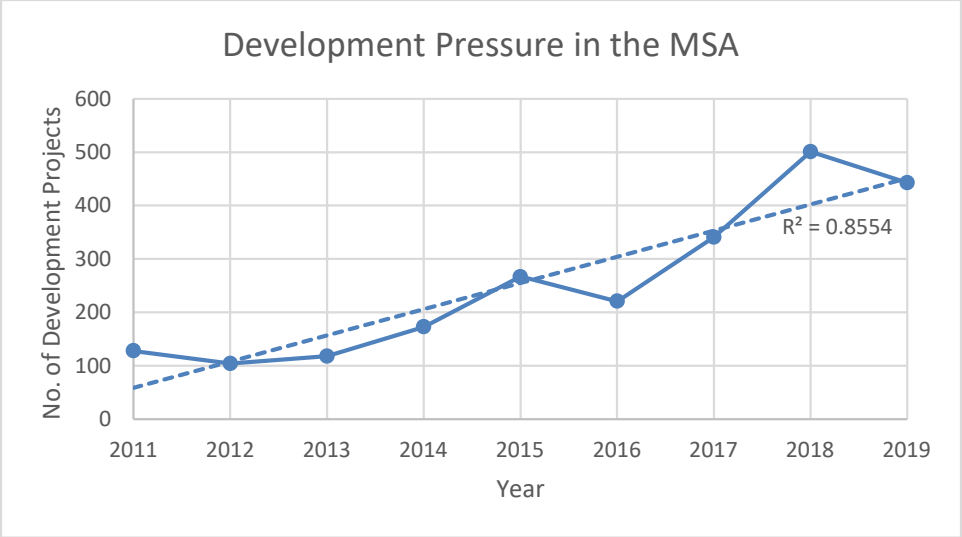
*more than one threat may be present in an EO.

The two most recent accidental herbicide spraying events involving Schweinitz's sunflower occurred in York County, SC in 2015 and Mecklenburg County, NC in 2018. As a result of these, and similar incidents, Duke Energy is implementing several precautionary measures (Fletcher 2019, Duke, pers. comm.). They are developing an "on-board" Geographic Information System to aid employees and contractors in identifying locations of sensitive habitats and species. In-field employees and contractors, as well as machinery, will be equipped with mobile tablets and mapping software that identifies "red zones" that should not be sprayed or that have specific management requirements. This technology should be in use by spring of 2020. Additionally, in 2018, recovery biologists with the Asheville and Raleigh field offices provided comments and recommendations for updated signage on Duke Energy powerline ROWs and species fact sheets. Installation of updated and new signs, at the sensitive habitat areas, began in the spring of 2019 (a total of 650 signs) and fact sheets are distributed to employees and contractors prior to ROW maintenance activities. The updated signs are in both English and Spanish, and are posted at eye-level.

NCDOT personnel monitored roadside EOs of Schweinitz's sunflower in NCDOT Divisions 7-12 in 2017 and 2018 (Frazer 2018a, Three Oaks, pers. comm.). Ninety-four EOs, representing 51 populations, whole or in part, were monitored (these include only those EOs not already accounted for in Appendix B). Of the 94 EOs, 43 were identified as needing mowing to mitigate woody succession and/or invasive species competing with Schweinitz's sunflower. Recommendations were made to NCDOT Divisions 10 and 12, and to Duke Energy regarding mowing needs (Frazer 2019b, Three Oaks, pers.comm.). Additional monitoring will be needed to determine if mowing regimes are changed.

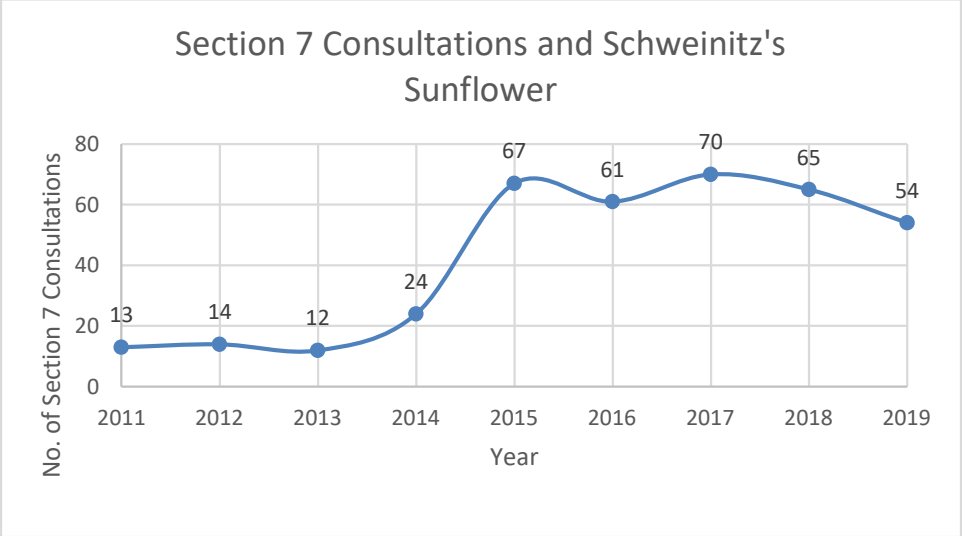
Frazer contacted multiple agencies about NCDOT ROW signage in early 2019 (Frazer 2019a, Three Oaks, pers. comm.). She noted that current signs request no mowing or spraying with little explanation. Although the intent of the signs is to alert mowers to not mow during the growing season, the unintended consequence is that some sites are never mowed. This results in woody succession and/or spread of invasives that compete with Schweinitz's sunflower. The NCDOT has a rare plant roadside population program in which roadside occurrences of federally listed plant species are posted, monitored, and maintained in such a way that chemical herbicides are used with utmost discretion (Knepp 2019, NCDOT, pers. comm.). Additionally, roadside mowing is planned when the plants are not flowering or fruiting. The NCDOT's Biological Surveys Group is working with the NCDOT Roadside Environmental Unit to better coordinate and develop the rare plant roadside population program (Knepp 2019, NCDOT, pers. comm.). As a result of this coordination, NCDOT has agreed to mow roadside sites using in-house forces which provides for more accountability and control when compared to using contractors. To prevent confusion regarding the timing of mowing, Frazer proposed changing NCDOT ROW signage to include only the no spraying instruction and omit the "do not mow" language altogether. The agencies contacted agreed with the decision to modify the signs and NCDOT has been replacing missing signs in Division 8, adding signs to protect a new population in Division 12, and a recommendation to use the signs was given to Division 6 (Frazer 2019b, Three Oaks, pers. comm.; Badgett 2019, NCDOT, pers. comm.). Due to current budget constraints, replacing all signs is not feasible at this time.

The Service's Environmental Conservation Online System, Tracking and Integrated Logging System (TaILS) is used to track Service activities, including Section 7 consultations and technical assistance requests. Although the database search includes only those projects with a Federal nexus and excludes non-Federal projects, it does provide a measure of potential development pressure in counties where Schweinitz's sunflower is known to occur. Since 2011, there have been 2,113 development projects reviewed by the Service in the 17 counties occupied by Schweinitz's sunflower. Approximately 66% (1,387) of those projects occurred in the Charlotte-Gastonia-Concord (Metrolina) Metropolitan Statistical Area (MSA), which includes Anson, Cabarrus, Gaston, Mecklenburg, Rowan, Union Counties in NC, and Lancaster and York Counties in SC (OMB 2018). The chart below shows the number of projects reviewed each year in the Metrolina MSA since the 2010 5-year review and the increasing trend in the number of development projects reviewed by the Service.



The Metrolina MSA, which includes York and Lancaster Counties in SC, continues to urbanize. York and Lancaster Counties grew by 3% from 2017 to 2018; the highest percentage of growth in the metro area. The metro area, as a whole, added an estimated 352,216 residents between 2010 and 2018, growing 15.9%, to reach 2,569,213 residents (Martin 2019).

A search for Section 7 consultations involving Schweinitz's sunflower yielded 380 records for informal (377) and formal (3) consultations in the Asheville, Raleigh, and South Carolina field offices (ECOS 2019) since the 2010 5-year review. Projects in the search results include: development (residential, commercial, and industrial), utilities (sewer, natural gas, and power), recreation (greenways, trails, and facilities), solar farms, road construction and improvement, cell tower construction, and mining. Development pressure on the species is likely to increase as urbanization of the species range continues. Also of note is the sustained increase in number of consultations since 2015 and the last 5-year review.



Recovery efforts for the species include "rescuing" plants from development project areas and relocating them to conserved and managed lands. The Service is aware of nine such projects that have been completed or are in planning stages since the 2010 5-year review (NCNHP 2018; Cabe 2018, Riverbanks Zoo, pers.comm.). Collaborators include: NCDOT, USFS, Mecklenburg County Parks and Recreation, Hanging Rock State Park, the Catawba Indian Nation, and private landowners. Success of these sites is largely dependent on time of relocation, and level of care and management after relocation. Additionally, in SC, plants are temporarily removed from construction sites and returned to their original location, if appropriate (Punsalan 2019).

b. Overutilization for commercial, recreational, scientific, or educational purposes: The Service was contacted by a resident of Columbia, SC in 2018 regarding apiculture (beekeeping) and Schweinitz's sunflower (Reid 2018). The individual notified the Service that he had collected Schweinitz's sunflower from Fort Mills, SC in approximately 2003 and planted them in his yard. It is unknown whether the plants were poached or legally obtained. When he began keeping bees in approximately 2008, he noticed bees using the flower and claimed bees preferred Schweinitz's sunflower over the approximately 100 other flowering plants in his bee yard. Since approximately 2013, he has been dividing and sharing Schweinitz's sunflower with other apiarists (beekeepers) in the Columbia area, 60 miles from the nearest known occurrence of Schweinitz's sunflower in York County, SC. Despite the Service's urging against the practice, he has no intention of discontinuing the distribution of Schweinitz's sunflower to other beekeepers. Plants grown in home gardens do not maintain natural levels of genetic diversity since they do not experience the same interactions with biotic and abiotic factors as in natural environments. Cultivating rare plants to maintain natural levels of diversity requires procedures and controls that cannot be duplicated in a home garden (CPC n.d.). At this time, the extent of this threat is unknown; however, those in the conservation community and working with Schweinitz's sunflower should be aware of plants outside of the known range and the potential for plant poaching for use in other bee yards.

c. Disease or predation: The 2010 5-year review identifies deer browse as a potential threat to the species; however, the severity and geographic scope was unknown at the time. In his 2017 thesis, England investigated the relationship between browsing and Schweinitz's sunflower population trends by tracking individual stems from seven sites in Mecklenburg County, NC and York County, SC during the 2013 growing season. Across the seven sites, 1,052 stems were tracked, with 3-6 observations recorded for each stem during the growing season. Thirty-eight percent of stems, at all sites, experienced browsing, and many stems experienced more than one browsing event. Browsing rates varied from 10-75% at the individual sites. Sites with populations previously identified as increasing or stable had browse rates of 32% or less, while sites identified as declining had rates of 32% or more. The condition of the severed stem-end was used to identify the type of species responsible for browsing; ragged, crushed stems were interpreted as deer damage and clean, angle-cut stems were interpreted as small mammal damage. England's (2017) observations led to the conclusion that browse damage is caused by multiple species including deer and small mammals, and the frequency of browse damage

shows a statistically significant relationship with population trends. England's (2017) results suggest that site managers should consider impacts from herbivores (including but not limited to deer) as a significant threat to the survival of the species.

The NCPCP monitors Schweinitz's sunflower at four Plant Conservation Preserves in NC. Browsing is noted during each monitoring event. From 2012 to 2017, an average of approximately 22% of stems, at all sites, experienced browsing. Browsing at individual sites averaged 3-33% over the five years (NCPCP 2017a). Browsing at the Redlair Preserve was significantly lower (average of 3%) than the other three Plant Conservation Preserves (average of 20-33%). Redlair Preserve is the only site where the NCPCP allows deer hunting (NCPCP 2018). All deer observations and confirmed kills are reported to the preserve steward and compiled to determine annual harvest statistics. From 2014 to 2017, an average of 151 deer were seen at the site each year. Hunters confirmed the death of an average of 19 deer each year resulting in an estimated control of 12.5% of deer. Though browsing rates vary among and within sites from year to year, preliminary observations suggest a positive correlation between deer hunting and reduced browsing pressure. The number of deer killed at Redlair Preserve each year is typically small; however, it is speculated that the presence of hunters is deterring deer from utilizing the site (NCPCP 2018).

Herbivory or browsing was noted in 36% of the 45 EOs (in 24 populations) with the potential to meet recovery criteria (NCNHP 2018; SCHTP 2017). Many land managers are trying to lessen herbivory impacts by erecting fencing or other physical barriers, applying "deer-off" spray, or allowing hunting.

During a reproductive biology study in 2012, Grubbs and Masters (2019) collected Schweinitz's sunflower heads and seeds from a study site at Winthrop University in York County, SC. Flower heads were examined and seeds were used in various germination tests. During testing, Grubbs and Masters (2019) noticed curved, pale gray larvae with reddish jaws on the seed germination paper. Seeds were empty and a single chewed exit hole was present in the seed hull. At the time, Grubbs and Masters (2019) suspected the larvae may be a member of the genus *Smicronyx* (a genus of weevil); however, the exact identification of the larvae was unknown. An adult weevil was captured at the same study site in 2013 and later identified as *Smicronyx pinguis*. No other *Smicronyx* species were collected from Schweinitz's sunflowers at the site; therefore, it was inferred that the larvae collected in 2012 were also *Smicronyx pinguis*. The weevil genus *Smicronyx* is frequently found on tubuliflorous (having all the flowers with tubular corollas) composites (Asteraceae), which like Schweinitz's sunflower, form a tuberous rhizome. Weevils tend to utilize seeds and/or stems of host plants. *Smicronyx pinguis* likely uses Schweinitz's sunflower seeds as a food source and an egg laying site. Grubbs and Masters (2019) observed that the adult weevils moved all over the plants, but they most frequently travelled between the leaves and immature heads during the pre-bloom stage; they did not find adult *Smicronyx pinguis* on Schweinitz's sunflower during the blooming period. The identification of *Smicronyx pingius* by Grubbs and Masters (2019) is the first state record of the species in SC and the first report of any *Smicronyx* species using Schweinitz's sunflower as a host. Although not found and described in NC to date, it is

possible that *Smicronyx pinguis* occurs in NC (Swink 2019, NCDA&CS, pers. comm.). Although weevil damage to the Schweinitz's sunflower in the SC study site was not extensive, it could be problematic if the weevil population expands. Because Schweinitz's sunflower produces a limited number of seeds each year due to the small head size (when compared with other perennial sunflowers), any reduction in seed production due to herbivory could further endanger the survival of the species (Grubbs and Masters 2019). Additional research should be done to determine which populations are affected by weevils, the extent the weevils are impacting populations, and ways to manage the weevil infestations.

d. Inadequacy of existing regulatory mechanism: In addition to the regulations referenced in the 2010 5-year review, there are other regulations and policies that protect plants on USFS property. USFS regulation 36 CFR 261.9 prohibits removing or damaging any plant that is classified as a threatened, endangered, sensitive, rare, or unique species. Additionally, Forest Service Manual 2673 establishes policy that prohibits the removal and collection of any threatened or endangered plants on lands under Federal jurisdiction except when authorized by permits. Although these regulations and policies should protect Schweinitz's sunflower on USFS property, lack of resources prevents monitoring of compliance and enforcement.

e. Other natural or manmade factors affecting its continued existence: While the threats discussed above present challenges in the near term, accelerated climate change could exacerbate threats, such as invasive species and competition, already affecting Schweinitz's sunflower. Although models of future climate scenarios are not yet available at a resolution conducive to site specific planning, it is reasonable to expect shifts in temperature and precipitation patterns that define the climatic conditions to which species such as Schweinitz's sunflower have become adapted. It remains to be seen whether or not these changes will exceed the adaptive capacity of this species.

D. Synthesis

Although monitoring for all 90 populations (278 extant EOs) is mostly infrequent and inconsistent, available data does suggest an increase in abundance in populations with potential to provide recovery (24 populations in NC and SC); however, only five populations in NC (representing four counties) and possibly one population in SC (representing one county) are currently of good to excellent viability. Threats identified in the 1990 listing rule and the 2010 5-year review are still current threats. Development pressure remains a significant threat to Schweinitz's sunflower and a TaILS database search yielded 380 consultations associated with the species range-wide since the 2010 5-year review. The Metrolina MSA, which includes York and Lancaster Counties in SC, continues to urbanize. While deer browse is known to be a threat to the species, small mammal and weevil herbivory has also been identified as impacting the species. Populations that are stable or increasing have maintained that status only through active land management to maintain suitable habitat conditions. Accidental herbicide spraying and lack of ROW maintenance impacts the species range-wide. Data and information outlined in this review highlight the need for continued management and consistent monitoring of abundance

and threats throughout the range. Schweinitz's sunflower continues to meet the definition of an endangered species under the Endangered Species Act.

II. RESULTS

A. Recommended Classification: No change is needed.

III. RECOMMENDATIONS FOR FUTURE ACTION

The 2010 5-year review included a list of recommendations to improve recovery of the species. These actions, listed below, remain applicable to species recovery.

- For sites with the potential to contribute toward the species' recovery, work with appropriate owners/managers to implement monitoring capable of producing reliable trend data at each site. Range-wide standardized monitoring protocol are generally not regarded as feasible for this species, due to the widely varying sizes of populations and the resources available to monitor them. However, site-specific protocol could be implemented such that counts or estimates provided at a given site are directly comparable from one monitoring period to the next.
- For sites with the potential to contribute toward the species' recovery, characterize existing vegetation using standardized community classification methods (e.g., NatureServe's community classification systems and Schafale and Weakley (1990)). Use this information to inform restoration objectives and direct future site protection efforts toward the highest quality habitats.
- Devise recovery criteria which balance the availability of suitable habitat with opportunities for restoration, management, and protection as dictated by landowner willingness and resource availability. These criteria should emphasize the role of prescribed fire in site restoration and management, but allow for those instances in which sites cannot be managed with fire.
- Work with Dr. Richard Houk (Winthrop University, retired) to find successors to continue his monitoring efforts in South Carolina.
- Clarify the role of controlled propagation, rescue and relocation, and public demonstration gardens in the species' recovery, so that sites supporting native populations in conjunction with remnants of native plant communities are prioritized for protection (above sites characterized by rescued and introduced plant material).

In light of new information, additional future actions are recommended below:

- Convene a working group of species experts to focus on species recovery. The working group would concentrate on, but not be limited to:
    - Defining populations, identifying populations on which to focus recovery, and assigning a responsible party for each identified population.
    - Determining what constitutes a "self-sustaining" population and determining the appropriateness of the criterion for a species dependent on active management.
    - Developing a standardized, tiered monitoring protocol that could be used on many different types of Schweinitz's sunflower sites.
    - Determining what constitutes a "natural" habitat considering the species' current relationship to the landscape (i.e. primarily in ROWs).
    - Clarifying the role of controlled propagation and relocation in recovery.

    - Providing support and, if feasible, pooling resources for management and monitoring.
    - Prioritizing unprotected sites that are critical for recovery and working towards permanent protection.
    - Having a regularly scheduled meeting to share resources and information.
- Support research to determine the geographical extent of *Smicronyx pinguis* (weevil) and level of threat to Schweinitz's sunflower.
- Support research to determine if Schweinitz's sunflower is hybridizing with other *Helianthus* species and to what extent.
- Encourage Departments of Transportation and utility companies to maintain ROWs in a manner that is beneficial to Schweinitz's sunflower.

IV. REFERENCES

Badgett, R. 2019. NC Department of Transportation, Raleigh, NC. Personal communication, email dated September 26, 2019.

Cabe, A. 2018. Riverbanks Zoo and Garden, Columbia, SC. Personal communication, email dated May 30, 2018.

Center for Plant Conservation. N.d. Gardeners can help prevent America's vanishing flora from slipping into extinction. Informational brochure. St. Louis, MO. 2pp.

England, B. 2017. Does browsing matter? Predation and population declines in the federally endangered Schweinitz's sunflower (*Helianthus schweinitzii*). Graduate thesis, Winthrop University. 137pp.

Fletcher, S. 2019. Duke Energy, Raleigh, NC. Personal communication, email dated September 25, 2019.

Frazer, M. 2018a. Three Oaks Engineering, Raleigh, NC. Personal communication, spreadsheet dated November 26, 2018.

-----. 2018b. Three Oaks Engineering, Raleigh, NC. Personal communication, email dated September 10, 2018.

-----. 2019a. Three Oaks Engineering, Raleigh, NC. Personal communication, email dated March 13, 2019.

-----. 2019b. Three Oaks Engineering, Raleigh, NC. Personal communication, email dated September 26, 2019.

Grubbs, K. and Masters, Z. 2019. First Report of *Smicronyx pinguis* (Coleoptera: Curculionidae) on Schweinitz's Sunflower (*Helianthus schweinitzii*) in South Carolina. Journal of Agricultural and Urban Entomology, 35(1): 15-20.

Hammerson, G., Schweitzer, D., Master, L., and Cordeiro, J. 2008. Ranking Species Occurrences – A Generic Approach. NatureServe, Arlington, Virginia. 10pp.

Houk, D. 2003. Status Survey and Protection Prioritization of Schweinitz's Sunflower (*Helianthus schweinitzii*) in York and Lancaster Counties, South Carolina. Prepared for the U.S. Fish and Wildlife Service, Cooperative Agreement No. 1448-40181-02-J-032. 30pp.

Knepp, C. 2019. NC Department of Transportation, Raleigh, NC. Personal communication, email dated October 22, 2019.

Martin, J. 2019. Metro Charlotte's population rises again, with these counties leading the surge. Charlotte Business Journal, Charlotte, NC. Accessed online at: https://www.bizjournals.com/charlotte/news/2019/04/18/gallery-metro-charlottes-population-rises-again.html.

NatureServe. 2004. Habitat-based Plant Element Occurrence Delimitation Guidance. Accessed online at: http://explorer.natureserve.org/decision_tree.htm. Accessed on February 2, 2017.

NatureServe. N.d. Definitions of EO Ranks and Origin Subranks. Accessed online at: http://help.natureserve.org/biotics/Content/Record_Management/Element_Occurrence/EO_Definitions_of_EO_Ranks_and_Origin_Subranks.htm. Accessed on November 7, 2019.

NC Natural Heritage Program. 2018. Element Occurrence records and scorecard for *Helianthus schweinitzii*. Print date August 30, 2018.

North Carolina Plant Conservation Program. 2017. Plant preserve monitoring data: 2012 - 2017. Raleigh, NC. Unpublished data.

-----. 2018. Report Section 6 Segment 33, FY 2017-2018. Raleigh, NC. 88pp.

Office of Management and Budget. 2018. OMB Bulletin No. 18-04 - Revised Delineations of Metropolitan Statistical Areas, Micropolitan Statistical Areas, and Combined Statistical Areas, and Guidance on Uses of the Delineations of These Areas. Washington, D.C. 227pp.

Punsalan, A. 2019. U.S. Fish and Wildlife Service, South Carolina Field Office. Personal communication, comments on draft 5-year review dated October 24, 2019.

Reid, R. 2018. Summary email regarding *Helianthus schweinitzii* and apiculture. U.S. Fish and Wildlife Service, Asheville, NC.

South Carolina Heritage Trust Program. 2017. Element Occurrence records for *Helianthus schweinitzii*. Print date November 6, 2017.

Smith, T. 2008. Spatial Analysis of *Helianthus schweinitzii* (Schweinitz's Sunflower), An Endangered Species Endemic to the Piedmont of North Carolina. Graduate thesis, University of North Carolina - Greensboro. 71pp.

Starke, L. 2019. North Carolina Plant Conservation Program, Raleigh, NC. Personal communication, email dated August 26, 2019.

Swink, W. North Carolina Department of Agriculture and Consumer Services, Plant Industry Division, Raleigh, NC. Personal communication, email dated July 24, 2019.

U.S. Fish and Wildlife Service. 1991. Schweinitz's sunflower (*Helianthus schweinitzii*) determined to be endangered. Federal Register 56: 21087 – 21091.

-----. 1994. Recovery Plan for Schweinitz's Sunflower (*Helianthus schweinitzii*). U.S. Fish and Wildlife Service, Atlanta, GA. 35pp.

-----. 2010. Schweinitz's sunflower (*Helianthus schweinitzii*) 5-Year Review: Summary and Evaluation. U.S. Fish and Wildlife Service, Asheville, NC. 27pp.

-----. 2019. Environmental Conservation Online System, Tracking and Integrated Logging System data for Schweinitz's Sunflower (*Helianthus schweinitzii*). U.S. Fish and Wildlife Service, Atlanta, GA. Accessed September 26, 2019.

U.S. Forest Service. 2003. Plant and Animal Collecting on National Forest – Regulation 36 CFR 261. Accessed online at: https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fsm91_054415.pdf.

-----. 2009. Forest Service Manual 2600 – Wildlife, Fish and Sensitive Plant Habitat Management, Chapter 2670 – Threatened, Endangered and Sensitive Plants and Animals, Section 2673.1 – Federally Listed Threatened and Endangered Species. U.S. Forest Service, National Headquarters, Washington, D.C. 24 pp.

U.S. FISH AND WILDLIFE SERVICE

5-YEAR REVIEW OF SCHWEINITZ'S SUNFLOWER

Current Classification: Endangered.

Recommendation resulting from the 5-Year Review:

____ Downlist to Threatened
____ Uplist to Endangered
____ Delist
_X_ No change needed

Review Conducted By: Rebekah Reid, Asheville Ecological Services Field Office

FIELD OFFICE APPROVAL:

Lead Field Supervisor, Fish and Wildlife Service

Approve JANET MIZZI Digitally signed by JANET MIZZI Date: 2019.12.17 15:05:53 -05'00' Date _____

APPENDIX A
Peer Review

Summary of peer review for the 5-year review of Schweinitz's sunflower (*Helianthus schweinitzii*).

A. **Peer Review Method:** Peer review was coordinated by the Service's Raleigh Ecological Services field office in North Carolina. Eight peer reviewers were selected by the Service for their knowledge of and expertise with Schweinitz's sunflower. Individual responses were received from five of the eight reviewers. Additionally, internal review was conducted by three members of the Service's South Atlantic-Gulf Region.

B. **Peer Reviewers:** The peer review request included personnel from:
Dr. James F. Matthews Center for Biodiversity Studies
NC Department of Transportation (NCDOT)
NC Natural Heritage Program (NCNHP) - two reviewers
NC Plant Conservation Program
SC Department of Environment and Natural Resources (SCDENR)
Three Oaks Engineering
U.S. Forest Service (USFS)

C. Peer Review Charge: Reviewers were asked to conduct a scientific review of technical information presented. Reviewers were not asked to review the legal status determination.

D. Summary of Peer Review Comments and Response: Reviewers from the Dr. James F. Matthews Center for Biodiversity Studies, SCDENR, and USFS did not respond to the request for review. Comments were received from all others in the Peer Reviewers list above. All substantive comments received were reviewed by the Service and incorporated into a revised version of this document, where appropriate. A brief summary of substantive comments is below.

The reviewer from the NCDOT clarified the rare plant roadside population program and provided information regarding coordination within the agency. This information was added where appropriate in Section II.C.2a.

The two reviewers from the NCNHP asked many clarification questions regarding methodologies and definitions of terms used in the review. The NCNHP reviewers also provided information regarding the interpretation of Element Occurrence ranks. Additional information was added throughout the document where appropriate and additional information was added to the administrative record to support changes from the 2010 5-year review.

The reviewer from the NC Plant Conservation Program suggested the use of summary tables in Section C. Tables were added as appropriate.

APPENDIX B

Populations of Schweinitz's sunflower with the potential to contribute to the recovery of the species. Populations are shaded in light gray, followed by sub-populations (not shaded).[1]

Site	County (NC)	EO#[2]	EO Rank[3]	Owner/Responsible Party[4]	Management Plan	Management Initiated	Native or Introduced[5]	Size Estimate from 2010 5-YR Review	Latest Size Estimate (year)	Trend[6]	ROW/Road Side[7]
Uwharrie NF: NC 109*		**44.000**	**C**							**inc**	
Buck Mountain	Montgomery	44.000	C	USFS	Y	N	N	150 stems (2005)	1760 stems (2017)	inc	Y
Shuffletown Prairie/Mountain Island Lake Dam*		**89.000**	**C**							**dec**	
Mountain Island Lake Dam	Mecklenburg	89.032	C	PRV	Y	Y	N	>1000 flowering stems (2002)	202 stems (2018)	dec	N
Shuffletown Prairie	Mecklenburg	89.051	C?	Meck Parks and Rec	Y	Y	N+I	2132 stems (2006)	72 stems (2018)	dec	Y
Latta Prairie/McCoy Road/Gar Creek*		**92.000**	**A**							**inc**	
Gar Creek Preserve (McCoy Road)	Mecklenburg	92.017	C	Meck Parks and Rec	Y	Y	N	1310 stems (2005)	1461 stems (2018)	stable	Y+N
Latta Plantation	Mecklenburg	92.139	A	Meck Parks and Rec	Y	Y	I	545 stems (2005)	>2500 stems (2018)	inc	Y+N
Redlair*		**95.000**	**A**							**stable**	
Redlair Plant Conservation Preserve	Gaston	95.000	A	NCPCP	Y	Y	N	2189 stems (2005)	2255 stems (2017)	stable	N
Mallard Creek Road		**104.000**	**C**							**dec**	
Mallard Creek Road Sunflower Site	Mecklenburg	104.236	D	NCDOT	Y	Y	N	n/a	30 stems (2017)	dec	Y+N
Uwharrie NF: Badin and Machine Branch*		**110.000**	**C**							**dec**	
Machine Branch Mafic Area	Montgomery	110.024	C	USFS	Y	N	N	201 flowering stems (2002)	214 stems (2017)	stable	Y
Badin Mafic Macrosite: FR576	Montgomery	110.192	D	USFS	Y	N	N	3 stems (2006)	16 stems (2017)	inc	Y
Badin Mafic Macrosite: FR6688	Montgomery	110.195	E	USFS	Y	N	N	>200 stems (2006)	1 stem (2017)	dec	N
Uwharrie NF: Roberdo		**111.000**	**B**							**inc**	
Railroad Mixed Pine Forest: Rocky Creek Macrosite	Montgomery	111.027	C	USFS	Y	Y	N	408 stems (2006)	408 stems (2006)	unk	Y
Roberdo Bog and Longleaf Pine Forest: Bruton-Capenter Rd	Montgomery	111.036	D	USFS	Y	Y	N	40 stems (2006)	106 stems (2017)	inc	Y+N
Clarks Grove Longleaf Pine Forest: NC109	Montgomery	111.061	C	USFS	Y	Y	N	317 stems (2006)	1079 stems (2017)	inc	Y+N
Clarks Grove Longleaf Pine Forest: powerline	Montgomery	111.067	D	USFS	Y	Y	N	29 stems (2006)	45 stems (2015)	inc	Y
Roberdo Bog and Longleaf Pine Forest: NC24/27	Montgomery	111.069	B	USFS	Y	Y	N	104 stems (2006)	50 (?) stems (2015)	dec	N
Boon Chesson	Montgomery	111.122	D	Three Rivers	Y	Y	I	<100 stems (2006)	10 plants (2019)	dec	N
Rocky Creek Macrosite	Montgomery	111.206	D	USFS	Y	Y	N	n/a	138 stems (2015)	inc	Y
Railroad Mixed Pine Forest: SW of Troy	Montgomery	111.246	D	USFS	Y	Y	N+I	n/a	15 stems (2015)	unk	Y+N
Mineral Springs		**112.000**	**A**							**inc**	
Mineral Springs Barren	Montgomery	112.013	A	NCPCP	Y	Y	N+I	534 stems (2002)	1716 stems (2017)	inc	Y+N

Site	County (NC)	EO#[2]	EO Rank[3]	Owner/Responsible Party[4]	Management Plan	Management Initiated	Native or Introduced[5]	Size Estimate from 2010 5-YR Review	Latest Size Estimate (year)	Trend[6]	ROW/Road Side[7]
McDowell Preserve and vicinity*		**138.000**	**A**							**stable**	
Winget Park	Mecklenburg	138.030	D	Meck Parks and Rec	Y	Y	N	334 stems (2006)	36 stems (2018)	dec	Y
McDowell Prairie	Mecklenburg	138.140	A	Meck Parks and Rec	Y	Y	I	1797 stems (2005)	2076 stems (2018)	stable/inc	N
McDowell Prairie/Dodge City Prairie	Mecklenburg	138.188	D	Meck Parks and Rec	Y	Y	I	n/a	7 stems (2018)	dec	N
Troy and Denson Creek		**141.000**	**BC**							**dec**	
Denson Creek Slopes	Montgomery	141.143	D	NCPCP	Y	Y	I	>500 stems (1999)	6 stems (2017)	dec	N
Denson Creek Slopes	Montgomery	141.203	C	NCPCP	Y	Y	N	n/a	228 (2017)	stable	N
Denson Creek Slopes	Montgomery	141.228	D	NCPCP	Y	Y	I	n/a	51 stems (2017)	inc	Y
Uwharrie NF: Morris Mountain*		**145.000**	**D**							**unk**	
Morris Mountain	Montgomery	145.000	D	USFS	Y	N	N	41 stems (2006)	41 stems (2006)	unk	Y
Uwharrie NF: Rabbit Mountain*		**146.000**	**C**							**dec**	
Rabbit Mountain	Montgomery	146.000	C	USFS	Y	Y	N	146 stems (2006)	97 stems (2017)	dec	Y
Harvest Field		**148.000**	**C**							**inc**	
Harvest Field Plant Conservation Preserve	Randolph	148.056	C	NCPCP	In prep	Y	I	no estimate	2333 stems (2017)	stable	Y
Walker Creek Forest	Randolph	148.129	D	USFS	Y	N	N	no estimate	79 stems (2011)	unk	Y
Wysner Mountain	Montgomery	148.198	A	PRV	Y	Y	I	1170 stems (2006)	4150 stems (2017)	inc	N
Long Mountain/Kings Mountain	Randolph	148.219	D	NCWRC	N	N	N	n/a	71 stems (2008)	unk	N
Harvest Field Plant Conservation Preserve	Randolph	148.253	B	NCPCP	In prep	Y	N+I	n/a	205 stems (2017)	inc	N
Purgatory Mountain*		**179.000**	**B**							**dec**	
NC Zoological Park Recovery Site	Randolph	179.000	B	NC Zoo	Y	Y	I	331 pots, 4-5 seedlings each (1997)	117 stems (2019)	dec	N
Sauratown Mountain Macrosite and Hanging Rock SP		**191.000**	**A**							**inc**	
Hanging Rock Reintroduction Site	Stokes	191.190	A	Hanging Rock SP	Y	Y	I	n/a	1049 stems (2012)	inc	Y+N
Caraway Mountain		**201.000**	**A**							**stable**	
Caraway Mountain - NC Zoo	Randolph	201.200	B	Pied Land Cons/NC Zoo	Y	Y	N	no estimate	74 clumps (2018)	dec	Y+N
Caraway Mountain - NCDOT	Randolph	201.223	A	NCDOT	Y	Y	N+I	651 stems (2008)	603 stems (2017)	stable	N
Cane Creek Park*		**217.000**	**A**							**inc**	
Cane Creek Park	Union	217.000	A	Catawba Lands	Y	Y	I	5993 stems (2009)	15327 flowering stems (2011)	inc	N
Surratt Road		**222.000**	**A**							**dec**	
Surratt Road - roadside	Davidson	222.124	C	NCDOT	Y	Y	N	839 flowering stems (2002)	404 stems (2017)	dec	Y
Surrat Road - interior	Davidson	222.221	B	NCDOT	Y	Y	I	no estimate	170 stems (2017)	dec	N

Site	County (NC)	EO#[2]	EO Rank[3]	Owner/Responsible Party[4]	Management Plan	Management Initiated	Native or Introduced[5]	Size Estimate from 2010 5-YR Review	Latest Size Estimate (year)	Trend[6]	ROW/Road Side[7]
Mountain Creek Corridor*		**229.000**	**D**							**inc**	
Sharpe Property	Richmond	229.000	D	Three Rivers	Y	Y	I	20 stems (2006)	82 stems (2018)	inc	Y+N
Flat Branch Hardpan*		**247.000**	**C**							**inc**	
Flat Branch Nature Preserve	Mecklenburg	247.000	C	Meck Parks and Rec	Y	Y	I	n/a	113 stems (2018)	inc	Y

Site	County (SC)	EO#	EO Rank	Owner/Responsible Party	Management Plan	Management Initiated	Native or Introduced	Size Estimate from 2010 5-YR Review	Latest Size Estimate (year)	Trend	ROW
Rock Hill South										**dec**	
Blackjacks Heritage Preserve	York	14,17-19, u/a	AB, BD, AC, F, u/a	SCDENR	Y	Y	N+I	7032 stems (2002)	876 stems (2018)	dec	Y+N
Fort Mill South										**dec**	
Banks Road/Duke Transmission	York	33	BD	Nation Ford	Y	Y	N+I	5680 stems (2002)	10,048 stems (2014)	Dec[8]	Y
Fort Mill North										**stable**	
Anne Spring Close Greenway - Site II	York	u/a	u/a	ASCG	Y	Y	I	57 stems (2002)	51 stems (2017)	stable	N
Brattonsville*										**inc**	
Brattonsville	York	47	BC	Nation Ford	Y	Y	I	315 stems (2002)	1218 plants (2015)	inc	N

[1] Principal Natural Heritage Program (NHP) Element Occurrence (EO) records (shaded in light gray) are herein regarded as proxies for populations of the species, whereas sub-EOs (no shading) represent site-specific locations within each population (sub-population) where plants have been documented to occur. NOTE: This table only lists those populations (and sub-populations) that show prospect of contributing to the long-term recovery of the species.

[2] NHP EO# use the following format: PrincipalEO.Sub (or stand-alone) EO.

[3] EO ranks listed here are from NHP EO reports (NCNHP 2018, SCHTP 2017). In a case where the latest size estimate is not included in the report, the reported NHP EO rank may not reflect the latest size estimate.

[4] The Owner/Responsible Party listing only includes the conservation entity that owns or holds a conservation easement on the property. Owner/responsible party abbreviations:

Abbreviation	Entity
ASCG	Anne Springs Close Greenway
Catawba Lands	Catawba Lands Conservancy
Hanging Rock SP	Hanging Rock State Park
Meck Parks and Rec	Mecklenburg County Parks and Recreation
Nation Ford	Nation Ford Land Trust
NC Zoo	NC Zoo - Asheboro
NCDOT	NC Department of Transportation
NCPCP	NC Plant Conservation Program
NCWRC	NC Wildlife Resources Commission
Pied Land Cons	Piedmont Land Conservancy
PRV	Private
SCDENR	SC Department of Environment and Natural Resources
Three Rivers	Three Rivers Land Trust
USFS	U.S. Forest Service

[5] "N" = native (no introduction or augmentation of plant material known to have occurred at any time in the past); "I" = introduced (plant material, either seeds, rootstock or both, was brought to this site from other location(s)). Combinations of these are possible, and are denoted as appropriate.
[6] For sites with a size estimate from the 2010 5-year review, latest size estimates were compared to the size estimate from 2010. For sites with no size estimate from the 2010 5-year review, latest size estimates were compared to previous monitoring events. A site is considered stable if the change in latest size estimate is less than 10% when compared to previous monitoring events or size estimate from 2010 5-year review.
[7] "ROW/Road Side" was determined using GIS, aerial photographs, and habitat descriptions in EO reports.
[8] Estimated size in the table is from 2014 before the site was sprayed with herbicide in 2015. Population abundance decreased as a result of spraying.
* Population entirely protected. A stand-alone populations is protected (public lands or conservation ownership) or all sub-populations (sub-EO) in a population are protected.