

American Hart's-tongue Fern
(*Asplenium scolopendrium* var. *americanum*)
5-Year Review:
Summary and Evaluation



U.S. Fish and Wildlife Service
New York Field Office
Cortland, New York

5-YEAR REVIEW

American Hart's-tongue Fern (*Asplenium scolopendrium* var. *americanum*)

GENERAL INFORMATION

Species: American hart's-tongue fern *Asplenium (Phyllitis) scolopendrium* var. *americanum* (= *Phyllitis japonica* ssp. *americana*) (AHTF)

Date listed: August 14, 1989

FR citation(s): 54 CFR 29726

Classification: Threatened

Critical habitat/4(d) rule/Experimental population designation/Similarity of appearance listing: None

Methodology used to complete the review:

In accordance with Section 4(c)(2) of the Endangered Species Act of 1973, as amended (ESA), the purpose of a 5-year review is to assess each threatened species or endangered species to determine whether its status has changed and if it should be classified differently or removed from the Lists of Threatened and Endangered Wildlife and Plants. The U.S. Fish and Wildlife Service (Service) evaluated the biology and status of the American hart's-tongue fern (AHTF) as part of a Species Status Assessment (SSA) to inform this 5-year review.

The SSA Report (USFWS 2020, entire) was prepared by the Service's New York Field Office, in collaboration with a SSA Core Team comprising representatives from the Service's Tennessee, Michigan, and Oregon Field Offices; the New York State Office of Parks, Recreation, and Historic Preservation (NYSOPRHP); the New York Natural Heritage Program; and the Michigan Natural Features Inventory. The SSA Report represents our evaluation of the best available scientific information, including the resource needs and the current and future conditions of the species. We developed two future scenarios of environmental and management conditions to discuss the viability of the species in the future. Independent peer reviewers and partner representatives reviewed the SSA Report before we used it to support a decision-making process reflected in the recommendation presented in this 5-year review.

FR Notice citation announcing the species is under active review: 89 FR 39113

REVIEW ANALYSIS

Application of the 1996 Distinct Population Segment policy: Not applicable

Recovery Criteria:

The AHTF Recovery Plan (Recovery Plan) (USFWS 1993, entire) outlined the following conditions that we believed would result in the species no longer meeting the definition of a threatened species:

- 1) It has been documented that at least 15 U.S. occurrences (2 in Alabama, 2 in Tennessee, 4 in Michigan, and 7 in New York) are self-sustaining and occur on sufficiently large tracts to ensure their perpetuation with a minimal amount of active management.

and

- 2) All of the above occurrences and their habitat are protected from present and foreseeable human-related and natural threats that may interfere with the survival of any of the occurrences.

The previous 5-year review (USFWS 2012, p. 18) recommended no change in the threatened status of the species as the recovery criteria had not been met; however, it provided seven recommendations for future actions that have largely been addressed, as discussed below. Currently, the existing recovery criteria have been met for populations in New York and Michigan, but not for Tennessee or Alabama; however, new information regarding population numbers and analyses regarding the species' future viability are available in the SSA Report (USFWS 2020, entire). Based on this new information and recovery activities completed subsequent to the last 5-year review, we find that the recovery criteria are no longer appropriate for evaluating the future viability of the species. The Recovery Plan was based on populations known to occur in the United States; however, recent information from the United States and Canada (COSEWIC 2016, entire) indicate there are currently 144 extant populations across the species' range. Additionally, the species is known to occur in Mexico, although little information is available on its status there.

Our recommended future actions from the last 5-year review (USFWS 2012, p. 18) and progress towards their accomplishment are listed below:

1. *Develop and implement a program to control [European] swallowwort [(Vincetoxicum rossicum)] at sites harboring AHTF populations in New York and provide for early detection and removal from sites in Michigan. This task is urgent given the prevalence of this threat to populations in New York and the rapid expansion of swallowwort that has been seen in sites where AHTF occurs.*

All protected sites in New York have an ongoing management and monitoring program for invasive species, including European swallowwort, implemented in partnership with the NYSOPRHP and supplemented with ESA section 6 and Great Lakes Restoration Initiative (GLRI) funding. The NYSOPRHP's efforts have been effective in controlling invasive species in the vicinity of the populations they protect and currently manage invasives in a maintenance mode in these areas. The NYSOPRHP has committed to continuing these efforts, and these efforts would not be negatively affected without the protections or funding support provided by the ESA. Sites in Michigan are monitored by the U.S. Forest Service and Michigan Nature Association. No occurrences of European swallowwort have been detected in Michigan to date.

2. *Fund and coordinate rangewide surveys of all populations at 2- to 5-year intervals.*

Due to the steep terrain, loose substrate, and sensitive nature of the sites where the AHTF occurs, we currently recommend surveys at a 5-year or greater interval. Nearly all of the U.S. populations have been surveyed since the last 5-year review, in coordination with efforts by the Service and other State and Federal partners. Survey efforts in Ontario have been more sporadic; however, 51 of the 112 populations in Ontario have been surveyed since 2010 (USFWS 2020, Appendix A).

3. *Conduct long-term monitoring of microenvironmental characteristics of sites in Tennessee and Alabama to document ranges of variability in factors such as humidity, soil moisture, solar insolation, abundance of bryophytes and herbaceous vascular plants, and canopy cover. These data will be necessary to evaluate whether regional changes in climate patterns affect site suitability at the localized scale.*

This effort has been attempted twice since the last 5-year review, with limited success due to rodent predation and data corruption issues (pers. comm., E. Watkins, Colgate University). Additional effort is planned in 2020-2021 to attempt to collect these data. While informative for the ecophysiology of the species and its adaptive capacity, we determined in the SSA Report that climate change is unlikely to affect the microclimatic conditions at the Tennessee and Alabama populations due to their partially subterranean locations that provide buffering for regional changes in climatic patterns (USFWS 2020, p. 68).

4. *Provide protection for the remaining occupied sites in Tennessee and Alabama.*

While not formally protected as defined in the SSA Report, and still privately-owned, the Tennessee and Alabama populations have agreements with the local landowners that limit some recreation and development at the populations. Additionally, the Alabama population is protected under the Alabama Cave Protection Law of 1988 that prohibits impacts to plants in caves in the State.

5. *Conduct detailed genetic studies of the species throughout North America to assess population genetic structure and to guide potential reintroduction/augmentation projects in Tennessee and Alabama.*

As discussed below, extensive genetic analyses have been completed on the AHTF by the State University of New York, College of Environmental Forestry (SUNY-ESF) and have been used to develop a reintroduction/augmentation program that includes propagates from Michigan, New York, and Alabama. Individuals from Tennessee have yet to be successfully propagated, although this is an area of active discussion and effort.

6. *Continue developing propagation techniques for the southern populations of AHTF and evaluate potential for augmenting or reestablishing populations at these sites using sporophyte material produced from collections made at southern sites.*

Propagates from Alabama are being considered for reintroduction at the extirpated Fern Cave (Morgue Pit), Alabama population on Service lands and at other potential locations in Alabama and Tennessee, in coordination with the State Natural Heritage Programs.

7. *Develop and implement a program to ensure that damage to or destruction of overstory trees by insect pests at occupied sites does not permanently alter site microclimate to the extent that the sites are no longer suitable for AHTF.*

The effects of overstory pests were thoroughly considered in the SSA Report (USFWS 2020, Section 4.4). We do not currently know of a method to implement that would adequately protect the existing populations from these pests; however, no widespread canopy pests currently appear to be affecting any known populations of the AHTF. We evaluated the likely future impacts of the Asian longhorned beetle (*Anoplophora glabripennis*) in the SSA Report due to this species' preference for sugar maple (*Acer saccharum*), the primary canopy species across most of the AHTF range, as discussed below. We did not find that the future impacts of this canopy pest, in conjunction with the other threats considered in the SSA Report, would cause the AHTF to become in danger of extinction in the foreseeable future.

Updated Information and Current Species Status

Biology and Habitat:

Pence (2015, entire) studied *ex situ* propagation and cryopreservation methods for AHTF from Alabama. She found that sporophyte production from gametophytes could take over 2 years; however, sporophytes were successfully produced and are being maintained at the Cincinnati Zoo. Propagated individuals were found to survive cryopreservation, which indicates these methods could be utilized to preserve germplasm materials.

Testo and Watkins (2013, entire) studied the gametophyte ecology of the AHTF and found that they had the lowest rates of germination and sporophyte production among all species studied and exhibited the greatest sensitivity to interspecific competition, temperature increases, and desiccation. Mature gametophytes of the AHTF grown at 25° C were 84.6 percent smaller than those grown at 20° C, and only 1.5 percent produced sporophytes after 200 days in culture. Similar responses were not observed in other species studied.

Brumbelow (2014, entire) studied the population and microclimate dynamics of the AHTF in New York. He provided long-term census data that indicated that declines observed in 2001 and 2002 (noted in USFWS 2012, p. 11) had largely reversed by 2011 and 2012. The AHTF habitats had significantly different microclimates from surrounding areas. Daily temperature ranges, daily minimum temperatures, and days with freezing temperatures were significantly correlated with sporophyte distribution within AHTF habitat.

Considerable effort has been placed on determining the genetic relationship and genetic exchange among populations of the AHTF. Genetic analyses are presented by Discenza (2012, entire), Fernando et al. (2015, entire), and Weber-Townsend (2017, entire) and summarized in the SSA Report (USFWS 2020, Section 2.6). These authors found that the diversity of the AHTF is generally low, and that genetic exchange among populations is also low, even over short distances, likely due to the limited dispersal capability of the spores (Serviss 2017, p. 83).

Species distribution models for the AHTF have been developed in New York (New York Natural Heritage Program 2012, entire) and in Canada (McCune 2016, entire; Rosner-Katz 2018, entire). These models found that metrics related to soil pH, adjacent shrub and forest cover, and depth to bedrock are important landscape predictors of existing populations of the AHTF. McCune (2016, p. 1875) utilized a model with success to locate three additional populations in Ontario.

Population Status

Since the AHTF was originally listed, the number of known extant populations of the AHTF increased in published reports from 16 populations in the United States, consisting of a few thousand individuals to 144 extant populations, 32 in the United States (12 in Michigan, 18 in New York, 1 in Tennessee, and 1 in Alabama) and 112 in Canada, as discussed in the SSA Report (USFWS 2020, pp. 16–17). We conservatively estimated the total population of the AHTF to be approximately 122,000 plants, although the lack of recent surveys at 81 populations in Ontario and 1 population in Michigan, which we believe represent approximately 48,000 plants, increased our uncertainty in that estimate.

Since the most recent reports from the Service (2012, entire) and COSEWIC (2016, entire), two populations have been determined to be extirpated, one in New York and one in Michigan, and four new small populations have been found, one in Michigan and three in Ontario. Three populations in New York, which were planted as part of a propagation program and are being monitored for long-term survival and reproduction, are included in our assessment of extant populations. Additionally, two populations in Michigan were formally surveyed for the first time following the preparation of these reports, and were found to be two of the largest populations in the United States.

In the SSA Report, we found there to be multiple, healthy (some very large) populations that are well-distributed across the northern portion of the range in the United States and Canada and two remaining southern populations in Tennessee and Alabama (one small and stable and the other declining). We described these two regions as two separate representative units: the Great Lakes Snowbelt and Appalachian Karst in order to describe the ecological and genetic variation across the species range (USFWS 2020, pp. 2, 30–33). As a whole, the Appalachian Karst Unit is composed of very few populations and individuals. While we predict the loss of one population in this unit in the SSA Report (USFWS 2020, p. 75), the best available information suggests that this representative unit was always composed of a few small, albeit unique, populations.

After the SSA was completed, in late 2019 and early 2020, the Service received a report of a potential population of the AHTF in El Malpais National Monument, New Mexico. The Service and other species experts (E. Watkins, Colgate University and W. Testo, University of Florida) conducted a survey of this population in February 2020. The population is located in an approximately 15-foot-diameter cave feature in a basaltic lava flow. The morphology of the gametophyte and isolated location suggest that this population is the AHTF based on the current taxonomic understanding of the species. Atypically, the bedrock is not calcareous; however, potential calcium deposition was noted on the surfaces of the cave walls. Genetic analyses by W. Testo and D. Fernando (SUNY-ESF) are planned in 2020-2021.

Threats Analysis (threats, conservation measures, and regulatory mechanisms):

Primary threats have not substantially changed since the last 5-year review; however, there are multiple efforts ongoing to address many of these threats; many threats are precluded at the majority of populations due to land protection and management activities. Current or potential future threats to the AHTF include logging (Factor A and D), development (Factor A), quarrying (Factor A), invasive species (Factor A and E), climate change resulting in increased drought and decreased winter snowpack (Factor A and E), collection (Factor B), recreation (Factor B), and observer impacts (Factor B). We provide a comprehensive review of the factors influencing the status (i.e., threats and conservation actions) of the species in the SSA Report (USFWS 2020, pp. 41–58). The purpose of a 5-year review is to recommend whether a listed taxon continues to warrant protection under the ESA and, if so, whether it should be reclassified (from threatened to endangered or from endangered to threatened). Hence, the analysis of the threats to the AHTF in the SSA is premised on the assumption that the species is not receiving the regulatory protections, funding, recognition, and other benefits of ESA listing.

In the SSA report, we identified climate change and invasive species as the most important factors to evaluate into the future (USFWS 2020, p. 58) as they are most likely to impact the majority of populations and individuals across the species' range. The other factors considered are localized or would only occur at unprotected, generally small, populations; they are not likely to be extensive across those populations based on historical trends across the species' range. We chose to include European swallowwort and the Asian longhorned beetle as two invasive species in future scenarios for the AHTF. These two species were chosen because they (1) are already present at or in areas near to current AHTF populations; (2) are expected to cause population-level impacts to the AHTF when present; and (3) are reasonably certain to occur within the range of the AHTF within the period of our future scenarios (USFWS 2020, pp. 67–73).

Conservation measures have benefited the AHTF, and the measures discussed below are expected to continue to provide benefits in the future whether or not the species is listed under the ESA. The AHTF is listed as Endangered in Michigan and Tennessee and Threatened in New York. Alabama does not have a State law equivalent to the ESA, so species do not have regulatory protection as State-listed endangered or threatened species. However, the AHTF is protected as a form of cave life by the Alabama Cave Protection Law of 1988 (AL Code § 9-19-3), whereby it is unlawful to remove, kill, harm, or disturb any plant or animal life found within any wild cave. In Michigan, it is unlawful to take a State-listed plant species without a permit (Part 365 of PA 451 § 324.36505, 1994 Michigan Natural Resources and Environmental Protection Act); however, in Tennessee and New York, collection or destruction of listed plant species is allowed without a permit on private lands with the permission of the landowner. The AHTF is listed as At-Risk in Canada and in Ontario with a status of “Species of Concern.” The AHTF on private lands in Ontario is afforded some protection (as discussed in Section 4.7, USFWS 2020) but is not protected from all impacts; however, the existing regulatory mechanisms provide more protection for Canadian sites on private lands than the ESA provides to sites on private lands in the United States.

There are currently 59 protected populations (41 percent) of the AHTF in the United States and Canada, with 34 protected populations in Ontario and 25 protected populations in the United

States (USFWS 2020, Appendix A). In the United States, most of the populations of the AHTF are protected: Michigan, Alabama, and Tennessee each have one unprotected population, and New York has four unprotected populations. Approximately, 62,000 plants (51 percent) occur at protected populations, and approximately 34,500 plants (28 percent) are partially protected, as several large populations in Ontario are extensive and not contained within parcels owned by a single landowner. Protection means that impacts from localized activities that cause extirpation or can heavily impact entire populations, such as development, quarrying, and logging, are not anticipated at these sites. In addition, habitat management efforts at protected sites include removal of invasive species, primarily in New York, and stewardship and planning efforts to limit impacts, including recreation, to individual plants.

In the last 5-year review (USFWS 2012, pp. 5–6), we noted several efforts to propagate the AHTF for conservation efforts. A propagation program funded by the GLRI and ESA Section 6 funding to the New York State Department of Environmental Conservation (NYSDEC) has been ongoing at the SUNY-ESF since the early 2010s (D. Fernando, SUNY-ESF). Earlier propagation programs had been unsuccessful at either growing the AHTF or establishing the plants in the wild due to the specificity of the growing requirements of the AHTF and the need to slowly acclimatize propagated individuals over several years. This recent effort resulted in the planting of three populations in 2015 that have been monitored over time and have apparently established at their respective locations (Serviss 2017, entire). This propagation program is transitioning from a research effort to a management program for rangewide propagation and New York invasive species control that the NYSOPRHP will direct. This effort has been initiated with GLRI funding, but then is expected to continue regardless of the protections of the ESA. Plants from New York, Michigan, and Alabama are currently under propagation at both SUNY-ESF and by NYSOPRHP. Regeneration of invasive plants from robust seed banks in the habitats will likely continue for many years into the future, requiring intensive management by New York State agencies, including the NYSOPRHP and the NYSDEC. However, as we note above, programs will exist to carry out these efforts even without the protections and funding afforded by the ESA.

Synthesis

Since the last 5-year review, considerable efforts have been conducted toward the recovery of, and collection of new information about, the AHTF. Regular surveys have noted generally stable populations at over 144 extant populations with extirpations of 3 very small populations. An estimate of the number of plants across the species' range is available for the first time. The majority of all populations and plants now occur at protected or partially protected locations. The genetics, ecology, life history, and propagation methods for the species have been studied in detail and used to develop a comprehensive SSA Report that has served as the basis of this 5-year review.

In the SSA Report, we predicted reductions in the number of AHTF populations and a strong eventual shift of some populations from High and Medium condition to Medium and Low condition populations in the absence of ESA listing. However, this analysis did not result in a likelihood that the species will become in danger of extinction. In general, we found that impacts due to climate change were the most important, primarily in New York and Ontario,

although invasive species exacerbated these projected declines. Protection and management of existing sites that are not contingent on ESA listing are reasonably expected to mitigate invasive species impacts. We predict that the northern Great Lakes Snowbelt Representative Unit will remain large and well-distributed, and that the Appalachian Karst Representative Unit will lose one of the two existing populations, but remain extant in all future scenarios.

Based on the species' current representation, resiliency, and redundancy and our analysis of threats and conservation actions that may influence the AHTF's future condition, we conclude that the AHTF currently has a low risk of extinction and also will likely have a low risk of extinction in the foreseeable future. Therefore, the AHTF is not in danger of extinction throughout all or a significant portion of its range and is not likely to become in danger of extinction in the foreseeable future, and it does not meet the definition of an endangered or threatened species.

RESULTS

Recommended Classification:

- Downlist to Threatened**
- Uplist to Endangered**
- Delist** (*Indicate reasons for delisting per 50 CFR 424.11*):
 - Extinction*
 - No longer meets the definition of Threatened or Endangered*
 - No longer meets the definition of a species*
- No change is needed**

New Recovery Priority Number: Not Applicable

Listing and Reclassification Priority Number, if reclassification is recommended (*see 48 FR 43098, September 21, 1983*)

- Reclassification (from Threatened to Endangered) Priority Number:** _____
- Reclassification (from Endangered to Threatened) Priority Number:** _____
- Delisting (Removal from list regardless of current classification) Priority Number:**
 6

Brief Rationale: The AHTF has a low management impact and this is a nonpetitioned action

RECOMMENDATIONS FOR FUTURE ACTIONS

Develop an appropriate Post-Delisting Monitoring Plan based on the biology of the species in coordination with the affected Service regions and States.

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U.S. FISH AND WILDLIFE SERVICE

5-YEAR REVIEW of the American Hart's-tongue Fern

Current Classification: Threatened

Recommendation resulting from the 5-Year Review:

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

Appropriate Listing/Reclassification Priority Number, if applicable: 6

REGIONAL OFFICE APPROVAL

Approve _____ Date _____

Assistant Regional Director – Ecological Services,
DOI Region 1 – North Atlantic-Appalachian