Sandplain Gerardia

(*Agalinis acuta*)

5-Year Review:

Summary and Evaluation

U.S. Fish and Wildlife Service
Region 5
New York Field Office
Cortland, NY

May 2019

5-YEAR REVIEW
Sandplain gerardia *(Agalinis acuta)*

1.0 GENERAL INFORMATION

1.1 Reviewers

Steve Sinkevich, Long Island Field Office (LIFO)	631-286-0485
John Wiley, New York Field Office (NYFO)	607-753-9334

Lead Field Office

David Stilwell, NYFO	607-753-9334

Cooperating Field Office

Tom Chapman, Susi von Oettingen, New England Field Office	603-227-6418
Genevieve LaRouche, Chesapeake Bay Field Office	410-573-4573

Lead Regional Office

Martin Miller, Region 5 Office	413-253-8615
Anne Hecht, Region 5 Office	413-575-4031

1.2 Methodology Used to Complete the Review

This review was completed by Steve Sinkevich, the lead biologist for sandplain gerardia (*Agalinis acuta*). Information used in this report was gathered from published and unpublished reports. State natural resource agency personnel, nongovernmental organization staff, and knowledgeable researchers and botanists were contacted for updated information. All pertinent available literature, reports, and other documents on file at the U.S. Fish and Wildlife Service's (Service; USFWS) LIFO were used for this review.

1.3 Background

1.3.1 Federal Register (FR) Notice Citation Announcing Initiation of this Review:

August 8, 2018 (Volume 83, No. 153, pp. 39113-39115)

1.3.2 Listing History

FR Notice: September 7, 1988 (Vol. 53, No. 173, pp. 34701-34705)
Date Listed: Final rule published September 7, 1988; effective October 7, 1988

Entity Listed: Species
Classification: Endangered

1.3.3 Associated Rulemakings/Actions: None

1.3.4 Review History

The 1989 Recovery Plan (USFWS 1989) included an assessment of the species' status. Various studies and surveys of sandplain gerardia have been conducted since the species was listed as endangered in 1988. Although a FR notice announcing the initiation of a 5-year review was published in 2008 (73 FR 3991-3993), this is the first completed 5-year review for this species.

1.3.5 Species Recovery Priority Number at the Start of the 5-Year Review:

The recovery priority for sandplain gerardia at the time of listing was 5C, indicative of a species with a high degree of threat (due to loss of the processes and/or land management practices that maintain suitable habitat) and low recovery potential, and a species in conflict with development projects.

1.3.6 Recovery Plan:

Name of Plan: Sandplain Gerardia (*Agalinis acuta*) Recovery Plan

Date Issued: September 20, 1989

2.0 REVIEW ANALYSIS

2.1 Application of the 1996 Distinct Population Segment (DPS) Policy

2.1.1 Is the species under review a vertebrate?

No, the species is a plant; therefore, the DPS policy is not applicable.

2.2 Updated Information and Current Species Status in the Range of *Agalinis acuta* (as Listed in 1988)

2.2.1 Biology and Habitat

2.2.1.1 Abundance

The number of plants observed in each state where surveys in the range of the taxon as listed were conducted since 2010 are:

State	2010	2011	2012	2013	2014	2015	2016	2017
Maryland[1]	2308	5825	12160	6000	49681	46522	48824	12206
New York[2]	6790	47972	5221	4380	7112	8821	20158	15572
Rhode Island[3]	2910	3248	776	515	1014	2591	3000	3118
Massachusetts[4]	32435	174873	1422	16115	57330	10039	45590	22198
Connecticut[5]	86	0	14	2	21	0	6	11
Total	44529	231918	19593	27012	115158	67973	53055	41382

Surveys are typically conducted in late summer or early fall. Sandplain gerardia is an annual species, and the populations are generally characterized as small and disjunct. These factors, in addition to the species' narrow microhabitat requirements and fluctuating weather conditions, account for significant increases or decreases from year to year. A long-lived seedbank often allows the species to persist at a site through years when no germination occurs. The Service recognizes the efforts of our recovery partners which have resulted in an increase from 1,218 plants at 10 sites in 1988 (USFWS 1989) to 41,382 plants at 13 sites surveyed in 2017 (the last year for which complete survey data are available), not including over 100,000 plants discovered at a Barnstable, MA, site in 2018 (Wernerehl *pers. comm*. 2018).

2.2.1.2 Habitat Management/Protection

The continuing threats to the species, cited in the listing of the species as endangered, include habitat loss and degradation from development, change in land use, vegetation succession, and the loss of the natural processes that maintain suitable habitat. With the exception of 3 privately owned cemeteries (where development is not likely to occur), each of the 21 sites described below are considered protected from development. The protection of populations (including the seedbank) at these sites addresses direct loss/degradation of habitat, identified in the Service's Recovery Plan (USFWS 1989) as the most significant threat to this species.

<u>New York (NY)</u>

Hempstead Plains: Owned by Nassau County, managed by the Friends of Hempstead Plains.

Sayville Grassland: Service-owned (Long Island National Wildlife Refuge Complex).

Montauk Downs/Shadmoor: Owned and managed by the NYSOPRHP with assistance from the TNC.

[1] Tyndall, Wayne. 2017. Personal communication. Maryland Natural Heritage Program, Department of Natural Resources.
[2] Long Island, NY, Cooperators (Monica Williams, USFWS; Annie McIntyre, New York State Office of Parks, Recreation and Historic Preservation [NYSOPRHP]; Betsy Gulotta, Friends of the Hempstead Plains; Paul D'Andrea, The Nature Conservancy [TNC]; Diana Sanford, Suffolk County Dept. of Parks, Recreation and Conservation). 2017. Personal communication.
[3] Raithel, Christopher. 2017. Personal communication. Rhode Island Department of Environmental Management.
[4]Wernerehl, Robert. 2017. Personal communication. Massachusetts Natural Heritage and Endangered Species Program.
[5] Moorhead, Bill. 2017. Personal communication. Connecticut Consulting Botanist.

Warhol: Owned and managed by the TNC.

Mashomack: Owned and managed by the TNC.

Roosevelt County Park: Owned and managed by Suffolk County.

Connetquot State Park: Owned and managed by the NYSOPRHP.

Central Pine Barrens: Owned and managed by Suffolk County.

Massachusetts

Cranes: State-owned and actively managed.

Oyster Watcha: Owned by Sheriff's Meadow Foundation (a private land trust on Martha's Vineyard); currently, no management is necessary, as the site has remained sandplain grassland over several years, with little or no woody plant encroachment.

Long Point/Scrubby Neck: Long Point is owned and managed by The Trustees of Reservations (a private land trust). Scrubby Neck is privately owned, and the TNC has an agreement with the landowner to allow management.

Katama Plains: Owned and managed by the TNC.

*Bayview/*Waquoit Bay National Estuarine Research Reserve (WBNERR): Bayview is a privately owned cemetery, with agreements between the Massachusetts Nature Conservancy and the Massachusetts Natural Heritage and Endangered Species Program (MANHESP) to manage portions for sandplain gerardia. The WBNERR is State-owned and is actively managed by the MANHESP for sandplain gerardia.

Percival Cemetery: Privately owned cemetery, with agreements to manage portions for sandplain gerardia.

Barnstable: Owned by the Town of Barnstable and managed by the Town of Barnstable and the MANHESP.

Maryland

Soldier's Delight: Owned and managed by the Maryland State Natural Areas Program.

Rhode Island

Richmond Cemetery: Privately-owned cemetery, with an informal registry agreement with the Rhode Island Natural Heritage Program (RINHP) that allows for protection and management of sandplain gerardia.

Eppley Preserve: Owned and managed by the Rhode Island Audubon Society with assistance from the RINHP.

Trustom Pond: Service-owned and managed (Trustom Pond National Wildlife Refuge).

Beaver River Preserve: Owned by the Richmond Land Trust and managed with assistance from the Rhode Island Department of Environmental Management.

Connecticut

Plainfield Cemetery: Privately owned cemetery, with an informal registry agreement with the Connecticut Natural Heritage Program, which allows for management of portions for sandplain gerardia.

2.3 Taxonomic Classification or Changes in Nomenclature

Recovery plan action 2.3 identified the need to resolve uncertainty regarding the distinctness of *Agalinis acuta* from closely related taxa that have morphological similarities, but largely non-overlapping ranges (see Figure 1 in Pettengill and Neel 2011). We summarize more than 10 years of research and associated discourse regarding the phylogenetic studies that inform the Service's consideration of the taxonomic status of *A. acuta*.

University of Maryland (Neel and Pettengill) Evaluation of the Evolutionary Distinctiveness of Agalinis acuta.

Dr. Maile Neel and then-graduate student James Pettengill at the University of Maryland conducted a 2006-2008 Service-funded study to determine whether *Agalinis acuta* was evolutionarily distinct under the criterion of monophyly (descended from a common evolutionary ancestor or ancestral group). They analyzed the evolutionary distinctiveness of *A. acuta* through three broad datasets: chloroplast DNA (cpDNA), microsatellites, and morphology. The cpDNA analyses indicated that *A. acuta*, *A. decemloba*, and *A. tenella* are closely related and are not genetically distinct. However, cpDNA is less effective for separating recently diverged species than other genetic markers, as chloroplast DNA sequences tend to change more slowly over time than other regions of the genome. Several methods were used to analyze the microsatellite data including neighbor joining trees (classification of individuals), STRUCTURE (model-based clustering method that assigns individuals to groups without *a priori* knowledge of originating population), and AMOVA (Analysis of Molecular Variance; model selection technique for evaluating grouping options). Microsatellites have a finer resolution for more recently diverged species. After careful consideration of potential shortcomings of microsatellites (and explicit efforts to guard against them), the analyses supported *A. tenella* as a separate taxon, but failed to support distinctiveness of *A. acuta* from *A. decemloba*. The morphology analyses included a wide variety of morphological traits and determined that *A. acuta* and *A. tenella* were well-separated with *A. decemloba* intermediate between the two. These reflect field-data collected for this analysis, as common garden experiments were not successful. In both their 2008 draft final[6] and 2009 final reports, the

[6] Neel and Pettengill used the term "draft final report" to distinguish it from earlier progress reports.

authors concluded that there was insufficient evidence to support the evolutionary distinctiveness of the listed taxon *A. acuta.* The 2008 draft final report concluded that *A. acuta* should be synonymized under *A. decemloba*. Following discussion with other experts, the 2009 final report recommended recognition of *A. decemloba* (circumscribed to include *A. acuta*) as a subspecific taxon within a species that included *A. tenella* as a second subspecies.

Peer Review of the Neel and Pettengill's 2008 Draft Report

The Service solicited peer-review of the draft final report by Neel and Pettengill (2008) from four recognized experts in plant evolution and/or genetics including: Dr. Canne-Hilliker, professor at the University of Guelph and the Flora of North America (FNA) Section Editor; Dr. Cheryl Morrison, a research geneticist with the U.S. Geological Survey (USGS); Dr. John F. Switzer, a USGS scientist; and Dr. Kent Holsinger, a professor at the University of Connecticut, with expertise in plant evolution and genetics. Three reviewers supported the conclusions of the analyses that suggested combining *Agalinis acuta* and *A. decemloba*. Dr. Canne-Hilliker supported the analysis and conclusion, stating that the methods used were appropriate and that the recognition of a single species with two varieties (*A. acuta* + *A. decemloba* and *A. tenella*) takes into account the bulk of the huge amount of data presented in this study. Dr. Morrison also agreed with the authors' overall interpretations, while stating that she "can imagine some differences in opinion in interpretation" of the authors' conclusions" and offering several recommendations for improvement of the report. Dr. Switzer found the study well-prepared and the data appropriate for this type of research; he also stated, "I would not recognize *A. acuta, decemloba*, or *tenella* as separate species" and "the results of this study will likely be interpreted in numerous ways." Conversely, Dr. Holsinger stated, "The evidence that *A. acuta* is a distinct evolutionary entity is very strong … The biological situation is clear: *A. acuta* is evolutionarily distinct from *A. tenella* and *A. decemloba*." Dr. Holsinger indicated similar independent analyses from his two graduate students and a post-doctoral fellow. See *Assessment of Peer Reviews*, below.

Subsequent Publication and Reviews

Subsequent to completing the final report in 2009, James Pettengill completed his dissertation (see Pettengill 2010) at the University of Maryland. Pettengill and Neel conducted further genetic/morphological analysis of *Agalinis acuta* and published an American Journal of Botany (AJB) paper in 2011. Pettengill and Neel (2011) presented refined analyses supporting their conclusions that there is insufficient evidence to support the evolutionary distinctiveness of the listed taxon *A. acuta*, that it should be synonymized under *A. decemloba*, and that *A. tenella* should be treated as a separate taxon.

Following the publication of the Pettengill and Neel 2011 paper, the Service requested that Dr. Alexander Krings, an assistant professor in the Department of Plant Ecology at North Carolina State University, review the paper. Dr. Krings concluded that the study does not put to rest the question of whether *Agalinis acuta* and *A. decemloba* represent distinct species. In 2018, John Wiley, a Service biologist with botanical expertise also conducted a review of Neel and Pettengill (2008, 2009) and Pettengill and Neel (2011), and the Service requested that Dr. Danilo Fernando, associate professor at the College of Environmental Science and Forestry, review the

reports and publication. Both Mr. Wiley and Dr. Fernando (Fernando *pers. comm.* 2018) identified some ambiguities with the microsatellite and morphological data.

Assessment of Peer Reviews

While the Service recognizes the knowledge and qualifications of each of the reviewers, we consider the FNA to be the taxonomic authority for plants that occur in North America. The FNA has completed a comprehensive taxonomic treatment for the section of *Agalinis* that includes *A. acuta/ decemloba*, (co-authored by Drs. Hays and Canne-Hilliker). While this treatment has not yet been officially published, the FNA indicated (Hays *pers. comm.* 2018a) that this treatment has gone through extensive editing and peer review, and is essentially the final version that will be published. The late-Dr. Canne-Hilliker's broad expertise with regard to the taxonomy of the genus *Agalinis*, her detailed peer review of Neel and Pettengill (2008), and her subsequent exchange of emails discussing the complete research results and critiques with the Service and Dr. Neel lend particular weight to her conclusions.

Many of Drs. Switzer, Morrison, and Holsinger's comments on the draft report were addressed in the final report. For example, the final report displayed the results of assignment analyses in STRUCTURE format (as opposed to the STRUCTURAMA format used in the draft report), addressing this concern identified by both Drs. Holsinger and Morrison. Some of the comments/concerns regarding the microsatellite analyses in the draft report were addressed in a correction in the final report, in which a lab error was identified that affected three populations (one of *Agalinis decemloba* and two of *A. tenella*).

Dr. Holsinger also had concerns with morphological traits being measured on field specimens rather than in experimental gardens. Neel and Pettengill (2009) shared this concern, but explained that due to the low germination rates discussed previously, they were unable to conduct a common garden study.

Dr. Krings, who did not review the genetics data in detail, expressed concern that Pettengill and Neel (2011) did not use all the morphological characters used historically and listed in Appendix S1 of the 2011 paper in their own analyses, specifically calyx lobe length. However, Dr. Canne-Hilliker concluded that using the length of the calyx lobes to distinguish *Agalinis acuta* and *A. decemloba* "does not work" due to great variation of this feature in *Agalinis* species (Canne-Hilliker *pers. comm.* 2008).

In summary, while valid concerns and questions have been raised by reviewers of Neel and Pettengill (2008, 2009), the Service recognizes that the AJB (an independent juried publication) ratified the findings of Neel and Pettengill (2009). The record also documents careful consideration of the strengths and weakness of these studies by Dr. Canne-Hilliker, culminating in her conclusion (with Hays) in the FNA that there is insufficient evidence to support the evolutionary distinctiveness of the listed taxon *Agalinis acuta*, and that it should be synonymized under the full species *A. decemloba*.

Botanical/Taxonomical Organizations That Accept Agalinis acuta Being Synonymized under A. decemloba

The FNA is in the process of publishing (Volume 17 "Under Production") the treatment for *Agalinis*, including *A. acuta* and *A. decemloba*. The galley proof and other communications from its co-author indicate that, based upon Pettengill and Neel (2008, 2011) and Pettengill (2010), the FNA will be including *A. acuta* within *A. decemloba* (Hays *pers. comm.* 2018a, 2018b). The Center for Plant Conservation (CPC) lists *A. decemloba* as an associated scientific name for *A. acuta* (CPC2018), the Integrated Taxonomic Information System (ITIS) lists *A. acuta's* accepted name as *A. decemloba*, and the University of North Carolina Herbarium/Botanical Garden (UNC) (Weakley 2015) has accepted FNA's treatment.

The FNA is a source of information that the Service considers to be the taxonomic authority for plants that occur in North America north of Mexico because it is a comprehensive, systematic account of the plants of North America; the FNA Project is a treatment of more than 20,000 plants (FNA 2018). Each FNA treatment "includes scientific and common names, taxonomic descriptions, identification keys, distribution maps, illustrations, summaries of habitat and geographic ranges, pertinent synonymy, chromosome numbers, phenology, ethnobotanical uses and toxicity, and other relevant biological information supplemented by a crucial review of the literature" (FNA 2018). The information is compiled, written, and reviewed by systematic experts from around the world, and revisions to the FNA are preceded by, and rely on, published taxonomic treatments.

The ITIS is the result of a partnership of Federal agencies (National Oceanic and Atmospheric Administration; USGS; U.S. Environmental Protection Agency; Agriculture Research Service; Natural Resources Conservation Service; National Museum of Natural History) formed to satisfy their mutual needs for scientifically credible taxonomic information. The goal of the ITIS is to create an easily accessible database with reliable information on species names and their hierarchical classification. The database is reviewed periodically to ensure high quality with valid classifications, revisions, and additions of newly described species. The ITIS includes documented taxonomic information of flora and fauna from both aquatic and terrestrial habitats (ITIS 2018).

Published by the Botanical Society of America continuously since 1914, the AJB is the Society's flagship research journal. The AJB publishes peer-reviewed (usually by two reviewers, in addition to an Associate Editor through a blind review process), innovative, significant research of interest to a wide audience of scientists in all areas of plant biology, all levels of organization (molecular to ecosystem), and all plant groups and allied organisms (cyanobacteria, algae, fungi, and lichens) (AJB 2018).

The CPC is a network of more than 40 leading botanic institutions that is dedicated to preventing the extinction of U.S. native plants. The CPC also works in research, restoration, technical assistance, education, and advocacy through the efforts of the network and the national office (CPC 2018).

The UNC, used by students, botanists, taxonomists, and other professionals from across the Southeast and the nation, currently contains over 800,000 specimens (UNC 2018) and published a working draft of the Flora of the Southern and Mid-Atlantic States (Weakley 2015).

Service Approach When Taxonomic Opinion Is Not Unanimous

The Endangered Species Act's (ESA) implementation regulations in title 50 of the Code of Federal Regulations (CFR) at 50 CFR 424.l l(a) and a 1992 Service Director's Memorandum (Memorandum) on "Taxonomy and the Endangered Species Act" (Service 1992) provide guidance on how to consider taxonomic information when assessing a species for listing (or possibly delisting) under the ESA. Under the regulations at 50 CFR 424.11(a), in determining whether a particular taxon or population is a species for the purposes of the ESA, the Secretary is to rely on standard taxonomic distinctions and the biological expertise of the Department and the scientific community concerning the relevant taxonomic group. The Memorandum specifies that "we are required to exercise a degree of scientific judgment regarding the acceptance of taxonomic interpretations, particularly when more than one possible interpretation is available." The Memorandum further states, "When informed taxonomic opinion is not unanimous, we evaluate available published and unpublished information and come to our own adequately documented conclusion regarding the validity of taxa."

Service Position

The Service places particular importance on the fact that Pettengill and Neel (2011) is the peer-reviewed, best-available information regarding the evolutionary distinctiveness of *Agalinis acuta*. This study forms the basis for the FNA's decision, accepted by the ITIS, the CPC, and the UNC, to synonymize *A. acuta* with *A. decemloba*. The Service acknowledges that not all reviewers agreed with the methodologies, results, and conclusions of the microsatellite and morphological analyses. However, based on our review of all the available scientific and commercial information, it is the Service's position that the taxonomic entity known as *A. acuta* is not a distinct species (Neel and Pettengill 2009; Pettengill 2010; Pettengill and Neel 2011; Hays *pers. comm.* 2018a, 2018b). The Service therefore concurs with the taxonomic revision recommended by Pettengill and Neel (2011) and the FNA synonymizing *A. acuta* under *A. decemloba*.

3.0 RESULTS

3.1 Recommended Classification

The recommended classification is to delist *Agalinis acuta* since, as described above, it no longer meets the statutory definition of a species. Due to this determination, the five factors and recovery plan criteria analyses are not applicable and are not addressed.

4.0 RECOMMENDATIONS FOR FUTURE ACTIONS

Because delisting due to taxonomic revision is recommended, future recovery actions under the auspices of the ESA for *Agalinis acuta* are not germane.

Due to concerns expressed by various experts regarding the potential vulnerability of *Agalinis decemloba*, as revised (Pettengill and Neel 2011), the Service helped fund surveys in several southeastern states in 2012 and 2013, but surveys remain incomplete. We do not currently

possess sufficient information (*e.g.*, assessment of survey effort, evaluation of current and foreseeable threats) to support a formal conclusion about whether ESA protection is warranted for the revised taxon. The NYFO and LIFO will continue to assess information from state botanists and other species experts, and may recommend that the Service include a status assessment of *A. decemloba* across its newly defined range in our workplans.

An important component of any preliminary or formal review of *Agalinis decemloba* would include the species' status in the Northeast, where the taxonomic revision does not change the number and size of its populations. However, thanks in large part to the efforts of our conservation partners, the size and number of populations, as well as protection and management at many sites in the five northeastern states have increased substantially since the 1988 listing of *A. acuta*. Additionally, *A. acuta/decemloba* is state-listed in Massachusetts, Connecticut, New York, and Maryland. Because our delisting decision is based wholly on the taxonomic revision, we have not assessed the effects of removing ESA status on current protection and management of this species.

5.0 REFERENCES

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U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW OF SANDPLAIN GERARDIA (*Agalinis acuta*)

Current Classification: Endangered

Recommendation resulting from the 5-Year Review: De-Listing

Review Conducted by: Steve Sinkevich, Fish and Wildlife Biologist _____

FIELD OFFICE APPROVAL:

David Stilwell, Lead Field Supervisor, U.S. Fish and Wildlife Service

Approve _____ Date 6/4/2019

REGIONAL OFFICE APPROVAL:

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

Approve _____ Date 6/19/2019