

RECOVERY PLAN AMENDMENTS FOR NINE SOUTHWEST SPECIES

The U.S. Fish and Wildlife Service identified best available information indicating the need to amend the below species' recovery criteria. Each amendment is recognized as an addendum that supplements the existing recovery plan.

Arizona Cliffrose (<i>Purshia subintegra</i>) Recovery Plan Original Recovery Plan Approved: June 16, 1995 Page(s) Superseded: 52-73
Davis' Green Pitaya Cactus (<i>Echinocereus viridiflorus</i> var. <i>davisii</i>) Recovery Plan Original Recovery Plan Approved: September 20, 1984 Page(s) Superseded: 11
Desert Pupfish (<i>Cyprinodon macularius</i>) Recovery Plan Original Recovery Plan Approved: December 8, 1993 Page(s) Superseded: 13-14
Fishes of the Rio Yaqui Recovery Plan Original Recovery Plan Approved: March 29, 1995 Page(s) Superseded: 21-22 Species Included: Yaqui chub
Little Aguja Pondweed (<i>Potamogeton clystocarpus</i>) Recovery Plan Original Recovery Plan Approved: June 20, 1994 Page(s) Superseded: 21
Navasota ladies'-tresses (<i>Spiranthes parksii</i>) Recovery Plan Original Recovery Plan Approved: September 21, 1984 Page(s) Superseded: 21-22
Nellie Cory Cactus (<i>Coryphantha minima</i>) Recovery Plan Original Recovery Plan Approved: September 20, 1984 Page(s) Superseded: 11
Texas Trailing Phlox (<i>Phlox nivalis</i> ssp. <i>texensis</i>) Recovery Plan Original Recovery Plan Approved: March 28, 1995 Page(s) Superseded: 13-14
Walker's Manioc (<i>Manihot walkerae</i>) Recovery Plan Original Recovery Plan Approved: December 12, 1993 Page(s) Superseded: 16-17

For

U.S. Fish and Wildlife Service
Southwest Region
Albuquerque, New Mexico

September 2019

Approved:


Regional Director, U.S. Fish and Wildlife Service

Date:

Sept. 26, 2019

Recovery Plan for *Phlox nivalis* ssp. *texensis* (Texas Trailing Phlox).

Amendment 1

Superseding only Part II, pages 13-14 of the Recovery Plan.

U.S. Fish and Wildlife Service
Region 2

September 2019

I. Background Information.

a. Summary of prior actions.

Listing:	56 FR 49636
Date:	September 30, 1991
Listed status:	Endangered
Recovery Plan:	Texas Trailing Phlox (<i>Phlox nivalis</i> ssp. <i>texensis</i>) Recovery Plan
Prepared by:	Dr. Michael J. Warnock, Sam Houston State University, Huntsville, Texas
Approved:	March 28, 1995
Five-year review(s):	August 30, 2018
Species Status Assessment:	September 2018

b. Reason for amendment.

The original Texas Trailing Phlox Recovery Plan (Recovery Plan) contains two downlisting criteria, yet no delisting criteria (U.S. Fish and Wildlife Service (USFWS) 1995, pp. 13-14). Since the publication of the Recovery Plan in 1995, the USFWS completed a 5-year status review (USFWS 2018a), a Species Status Assessment (SSA) (USFWS 2018b), and updated the Minimum Viable Population (MVP) estimate (Poole *et al.* 2000). The SSA found that only seven populations of Texas trailing phlox are known to exist, they are endemic to a small geographic area, and the subspecies' genetic diversity is unknown; therefore, representation and redundancy values remain low (USFWS 2018b). Known population estimates are well below the current MVP (Poole *et al.* 2000) estimates used to define downlisting in the 1995 Recovery Plan, thus the subspecies exhibits low resiliency. The 5-year status review of Texas trailing phlox did not recommend a change in listing status (USFWS 2018a, p. 6). Based on this information, we recommend updating the Recovery Plan to include revised downlisting and delisting criteria that include a new MVP and subspecies' information.

II. Methods used to revise recovery criteria.

The draft SSA was peer-reviewed in October 2018 and reviewer recommendations have been incorporated into the final document. We will request peer-review of this recovery plan amendment during the public comment period for the revised recovery criteria.

There is no regionally approved recovery team that oversees the Texas trailing phlox. However, we worked closely with members of the plant conservation community in East Texas to gather information about the subspecies and its population demographics. We requested information from: Texas Natural Diversity Database managers and botanists at Texas Parks and Wildlife Department (TPWD); The Nature Conservancy (TNC); the Big Thicket National Preserve (BTNP, U.S. National Park Service); private landowners and land managers; and, academic institutions (Stephen F. Austin State University – Pineywoods and University of Texas-Austin).

Defining quantitative Texas trailing phlox delisting criteria is predicated on our rationale that successful conservation and recovery efforts will alleviate threats to this subspecies and lead to stable or improving demographic trends. Monitoring the Texas trailing phlox will be important to track and determine the success of these efforts. We defined a population monitoring period (30 years) based on the subspecies' life history in order to show that threats have been alleviated and there is a change in the demographic trends. If it is determined at the end of this monitoring period, that threats are alleviated and demographic trends remain stable or improve, then we will review its listing status under the Endangered Species Act (ESA).

III. Adequacy of the original recovery criteria.

Section 4(f)(1)(B)(ii) of the ESA requires that each recovery plan shall incorporate, to the maximum extent practicable, “objective, measurable criteria which, when met, would result in a determination...that the species be removed from the list.” Legal challenges to recovery plans (see *Fund for Animals v. Babbitt*, 903 F. Supp. 96 (D.D.C. 1995)) and a Government Accountability Audit (GAO 2006) have also affirmed the need to frame recovery criteria in terms of threats assessed under the five delisting factors.

a. Recovery Criteria in the current Recovery Plan (USFWS 1995, pp. 13-14).

Preliminary downlisting requirements were identified. The Texas trailing phlox will be considered for reclassification from endangered to threatened status when:

1. At least 12 self-sustaining populations, in at least three counties, have been established. A population will be considered self-sustaining if it reaches and maintains a population number of at least 100 plants. The numbers of plants and populations must be verified through adequate monitoring.

The Recovery Plan (USFWS 1995, p. 13) defines a “population” as: (1) a group of plants separated by a distance of at least 2 kilometers (km) (1.2 miles (mi)) from any other plants of Texas trailing phlox; or, (2) a group of at least 300 plants covering an area, at the maximum, of one km² (247 acres). A “plant” is defined as a cluster of

Texas trailing phlox stems with no above-ground connection to other groups of stems, and separated by a distance of at least 5 decimeters (dm) (1.6 feet (ft)).

2. Sufficient, documented protection measures and management plans have been established for these 12 self-sustaining populations. Long-term, binding agreements are preferable for populations on private lands since they provide the management continuity necessary to achieve and ensure recovery.

If, at any point following downlisting, these requirements are no longer being attained, the Texas trailing phlox should be immediately returned to “endangered” status.

b. Analysis.

The Recovery Plan does not explain how the criterion of 100 plants per population and the need for 12 self-sustaining populations were developed. Additionally, the Recovery Plan does not define how the extent of the population size (acreage) was derived. When the Recovery Plan was published in 1995, there were only two known sites in southeast Texas: the type locality in Hardin County, and another site in Tyler County. Since then, 17 additional sites were identified in Hardin, Polk, and Tyler counties; however, all these sites are considered extirpated. The most recent survey and monitoring data indicates a total of seven extant populations for Texas trailing phlox (USFWS 2018b).

No current global scale population estimate is available for this subspecies, but local population estimates range from 1 plant (found at Resource Management Services, Tyler County in 2018) to over 500 plants (found on timber conservation lands, in Hardin County in 1996) (USFWS 2018b).

Within southern pine ecosystems, many plants, including the Texas trailing phlox, are well adapted to and/or require frequent burning. Texas trailing phlox has rebounded and flowered after growing season burns in the summer months, however, timing and frequency of burns is critical to prevent destruction or damage of reproductive parts and potential impediment of reproductive processes (i.e. opportunity for pollination) of this subspecies. Fire is an important process to maintain optimal canopy structure for Texas trailing phlox. Maxey and Warnock (1996) investigated the impacts of management (including prescribed burning, canopy thinning, and combined management) on the subspecies. They found that management activities promoting an open canopy of pines (5-25 percent); less than 40 percent coverage of subcanopy pines (pines and hardwoods); and, less than 40 percent shrub coverage (Maxey and Warnock 1996, p. 37), was the most reproductively beneficial to the subspecies.

Prescribed burning is an effective management tool and has been used to create optimal habitat conditions, therefore the recovery potential of the subspecies remains high. However, not all populations are managed with prescribed burns on a routine basis and encroachment of habitat is the likely culprit for reduced population abundance and distribution across its range. None of the populations currently meet or exceed the current MVP value of 100 individuals necessary for downlisting. Although we lack data that speaks to the quantity of habitat needed by Texas

trailing phlox, we can describe the optimal habitat quality conditions needed. These habitat quality parameters include: an open canopy of pines (5-25 percent); less than 40 percent coverage of subcanopy pines (pines and hardwoods); and, less than 40 percent shrub coverage (Maxey and Warnock 1996, p. 37). Therefore, we determine that the criterion should reflect optimal habitat conditions as described by Maxey and Warnock (1996).

To define the resiliency of Texas trailing phlox, we use the MVP and quality habitat standards. The MVP estimate of a population should reflect the best available scientific literature and the needs of the species to sustain its viability. Currently, the Recovery Plan defines downlisting as either 100 individual plants or a group of 300 plants covering 1 km². A conventional MVP, as outlined in Pavlik's guidelines (1996, p. 137), uses the biologic and demographic information known about a species to estimate a MVP size in order to prevent extinction. A conventional MVP does not exist for the Texas trailing phlox, as the baseline data needed to perform these calculations is not available. We lack consistent population counts across the subspecies' range, and genetic analyses on the relatedness of the plants within and between populations, which are important for a conventional MVP. However, Poole *et al.* (2000) estimated the MVP using Pavlik's method (1996). Their MVP estimate states that each population of Texas trailing phlox needs approximately 600 individual reproductive plants (Poole *et al.* 2000, pp. 63-66).

There are genetic concerns with small population sizes, including reduced availability of compatible mates, genetic drift, inbreeding depression, and vulnerability to stochastic events (Ellstrand and Elam 1993). Small populations have low resilience, leaving them particularly vulnerable to stochastic events, such as extreme flooding. Stochastic variation in demographic rates can result in random population size fluctuations that are not generally detrimental to larger populations, but have the potential to result in extirpation of smaller populations. Based on the MVP estimate by Poole *et al.* (2000) and the need for robust population sizes to withstand stochastic events, we believe that use of the MVP is an appropriate component of the viable population size criterion.

Delineating Texas trailing phlox populations by defining their connectivity, distribution across the landscape, and global population size is key to apply the MVP criterion and describe redundancy. For plant species that reproduce sexually and require pollination, connectivity is often described in terms of flight distances of associated pollinators. Pollinators observed visiting Texas trailing phlox flowers include carpenter bees (*Xylocopa* spp.) (M. Quinn, pers. comm. 2008), Nessus sphinx moth (*Amphion floridensis*) (G. Grant, pers. comm. 2017), and Eastern Tiger swallowtail butterfly (*Papilio glaucus*) (G. Grant, pers. comm. 2014), but also likely include various species of flies, bees, and butterflies (TPWD 1997, p. 1; USFWS 1995, p. 9; Maxey and Warnock 1996, p. 10). Poole *et al.* (2000, p. 3) notes that there is also the potential for large terrestrial arthropods to act as pollinators. Although we have anecdotal evidence that suggests what species visit Texas trailing phlox flowers, we do not know if these species are effective pollinators.

Outcrossing, the production of offspring by the fusion of distantly related gametes, can play an important role in plant resiliency. Based on the flower morphology, we know that Texas trailing phlox is an outcrossing subspecies pollinated by moths and butterflies (Bogler 1992, p. 5). Thus, having healthy populations of these pollinators is essential to its reproduction. However, it is not

known whether flowers are obligate or facultative outcrossers (Maxey and Warnock 1996, p. 10; USFWS 1995, p. 9). We cannot draw definitive conclusions about the typical foraging distances for these pollinators. Populations that are closer together geographically and within pollinator foraging distances are likely to attract more pollinators and have an increase in pollination services (i.e. fertilization and seed production). These populations also provide the necessary breeding and foraging resources for the pollinating species.

We conclude that populations connected by a distance of at least 2 km (1.24 mi) allow for pollinator visitation and foraging, as well as exchange of genetic material. Therefore, we agree with the original criterion that we should define a population as being at least 2 km from another Texas trailing phlox population.

Redundancy is a species' ability to endure catastrophic events. Redundancy is determined by the distribution, number, and resiliency of populations. Species that have resilient populations spread throughout their historical range are less susceptible to extinction. Viable populations should have gene flow either through pollination or seed dispersal. Exchange of genetic material is more feasible with connected populations. Texas trailing phlox seeds are dispersed only short distances (through explosive seed dispersal) and therefore, stochastic events are the plausible mechanism for longer distance dispersal and exchange of genetic material. We anticipate that populations exchange gene flow either through stochastic events and/or through pollinators. Historically more populations likely occurred on the landscape, which would have connected the existing extant populations. However, with habitat alteration and modification, suitable habitat was depleted or the existing populations became more genetically isolated. The Texas trailing phlox is distributed throughout a 3-county geographic range in Texas including Hardin, Tyler, and Polk counties. Therefore, we believe that the criterion should include the known geographic range of the subspecies.

The USFWS recognizes that there are seven known extant populations, including four natural and three ex-situ sites (USFWS 2018a, 2018b). Many historic sites were lost because of impacts from habitat modification, loss, and/or fragmentation. These impacts continue to be the primary stressor to the subspecies. The 5-year review points to the need: for extensive collaboration with private landowners and land managers; to develop a habitat suitability map; and, to develop a controlled propagation and reintroduction plan (USFWS 2018a, pp. 4-5).

We recognize that the viability of Texas trailing phlox could rely on ex-situ populations and, therefore, these should be considered as part of both downlisting and delisting criterion, as long as the populations are self-sustaining. The Recovery Plan identified preliminary downlisting criteria to need 12 self-sustaining populations. Given that this is the best scientific information available, we conclude that the 12 populations provide a sufficient level of redundancy to downlist the subspecies. Texas trailing phlox has not met this criterion at any time following its listing. To secure redundancy of the subspecies into the foreseeable future, we estimate that additional populations would be needed, at least three additional populations within the known geographic range. Thus, we conclude that 15 self-sustaining populations should provide sufficient redundancy to delist. It is unknown how habitat modification, loss, and fragmentation associated with industry (oil/gas, timber); land management practices; and climate change will affect Texas trailing phlox. Long-term, binding agreements with landowners and land managers

are needed to ensure conservation of the habitat in perpetuity. Protected populations that contribute to delisting must be monitored to detect demographic trends and responses to these stressors.

Given optimal conditions, the Texas trailing phlox may live for at least six years (Maxey and Warnock 1996, p. 37). Anecdotal survey records suggest that Texas trailing phlox can persist longer than six years, as the subspecies is a longer-living perennial. For example, individuals planted in 2007 are still thriving at the Hancock site in Tyler County (R. Bounds, pers. comm. 2018). Additional observations indicate that plants currently known from The Nature Conservancy properties in 1993 are still persisting today (W. Ledbetter, pers. comm. 2019). Therefore, we estimate that the average lifespan of the Texas trailing phlox to be around 10 years (USFWS 2018b). Since the Texas trailing phlox is a longer-lived species, monitoring should be reflective of this life history trait. In order to capture long-term trends, an average of three generation cycles has historically been used to assess variability and effects on population viability. Therefore, we estimate that the 15 populations should be monitored for 30 years.

IV. Amended Recovery Criteria.

a. Downlisting Recovery Criteria.

Based on the information in the SSA (USFWS 2018b) and the 5-year review (USFWS 2018a); we developed downlisting criteria that justify a reclassification from endangered to threatened. Texas trailing phlox will be considered for downlisting when:

1. At least 12 self-sustaining populations, distributed across the known geographic range of Hardin, Polk, and Tyler counties, Texas, are established. There should be at least three populations located in each county in order to provide adequate representation. The remaining three populations can be distributed in any fashion among the available habitat across the geographic range. A population will be considered self-sustaining if it reaches and maintains a population number of at least 600 reproductive individual plants. A population is considered a group of plants separated by a distance of at least 2 kilometers (km) (1.2 miles (mi)) from any other Texas trailing phlox plants, as to promote healthy populations of pollinators and the exchange of genetic material. A “plant” is defined as a cluster of Texas trailing phlox stems with no above-ground connection to other groups of stems, and separated by a distance of at least 5 decimeters (dm) (1.6 feet (ft)). Habitat will be of sufficient quality as defined by Maxey and Warnock (1996), that it promotes the success of Texas trailing phlox.

The numbers of plants and populations must be verified through adequate monitoring. Populations can include both natural and ex-situ (introduction and reintroduction) efforts. To be considered under this criterion, the habitats of Texas trailing phlox must be managed in a manner that promotes the continued survival of the subspecies. Management can include, but is not limited to, prescribed burning and/or restoration of longleaf pine habitat.

2. Sufficient, documented protection measures and management plans have been established for these 12 self-sustaining populations. Long-term, binding agreements that aim to conserve and protect the subspecies, and its habitat, are preferred. Private lands should be a priority focus for these agreements; however, protected areas can and should include lands owned by federal, state, or local government agencies.

b. Delisting Recovery Criteria.

Texas trailing phlox will be considered for delisting when:

1. To secure redundancy of the subspecies into the foreseeable future, we conclude that more populations would be needed for delisting. Therefore, at least 15 populations distributed across the known geographic range of Hardin, Polk, and Tyler counties, Texas, have been established. At least four populations should be located in each of the counties in order to provide representation of the potential genetic and ecological diversity of the subspecies. The remaining three populations can be distributed in any fashion among the available habitat within the range. A population will be considered self-sustaining if it reaches and maintains a population number of at least 600 reproductive individual plants. Ex-situ efforts should be focused within the known geographic range unless habitat suitability mapping proves otherwise. Habitat will be of sufficient quality, as defined by Maxey and Warnock (1996), that it promotes the success of Texas trailing phlox.
2. Monitoring efforts indicate that the MVP level of 600 reproductive plants at each population has remained stable or has increased over a monitoring time period of 30 years. Monitoring must be routine in order to gauge subspecies' viability. Site-specific management plans should be aligned with landscape scale strategies to attain optimal habitat quality conditions that promotes the Texas trailing phlox.

IV. Literature Cited.

- Bogler, D. 1992. Stewardship summary for Texas trailing phlox. Texas Nature Conservancy, San Antonio, TX.
- Bounds, R. 2018a. Electronic Communication, "Reminder: WebEX and call on May 8 from 2-3:00." May 7, 2018. 3 pp, +attachments.
- Ellstrand, N. C., and D. R. Elam. 1993. Population genetics of small population size: implications for plant conservation. *Annual Review of Ecology and Systematics*. 23: 217–242.
- Grant, G. 2014. Electronic Communication, "Another Grant image....FW: Tiger swallowtail on tx trailing phlox." April 6, 2014. 1 p.
- Grant, G. 2017. Electronic Communication, "Nessus sphinx moth on more than one occasion on Phlox at SFAFW: Phlox pollinator." July 25, 2017. 1 p.

- Maxey, R. and M. Warnock. 1996. Final Report, Inventory of the Texas Trailing Phlox (*Phlox nivalis* ssp. *texensis*), with Emphasis on Management Concerns. Texas Parks and Wildlife Department, Grant E-2-2, Project No. 42. 39 pp.
- Ledbetter, Wendy. 2019. Electronic Communication, “RE: Peer review request”, comment regarding Texas trailing phlox longevity. April 10, 2019. 1 p.
- Pavlik, B.M. 1996. Chapter 6: Defining and measuring success. Pp. 127-155. In, D.A. Falk, C.I. Millar, and M. Olwell. Restoring diversity, strategies for reintroduction of endangered plants. Island Press, 505 pp.
- Poole, J., D. Price, and K. Kennedy. 2000. *Phlox nivalis* ssp. *texensis*, population information and MVP. November 7, 2000. 4 pp.
- Quinn, M. Electronic Communication, “RE: Texas Trailing Phlox pollinator.” May 29, 2008. 4 pp.
- Texas Parks and Wildlife Department. 1997. Texas trailing phlox, fact sheet. 1 p.
- U.S. Fish and Wildlife Service. 1995. Texas Trailing Phlox (*Phlox nivalis* ssp. *texensis*) Recovery Plan. 42 pp.
- U.S. Fish and Wildlife Service. 2018a. Five Year Review: Summary and Evaluation, Texas Trailing Phlox (*Phlox nivalis* subspecies *texensis*). Texas Coastal Ecological Services Field Office, Houston, Texas.
- U.S. Fish and Wildlife Service. 2018b. Draft Species Status Assessment for Texas Trailing Phlox (*Phlox nivalis* subspecies *texensis*). Species Status Assessment Reports. Texas Coastal Ecological Services Field Office, Houston, Texas.

APPENDIX A – SUMMARY OF PUBLIC, PARTNER, AND PEER REVIEW COMMENTS RECEIVED

Summary of Public Comments

We published a notice of availability in the *Federal Register* on June 27, 2019 (84 FR 30764-30768) to announce that the draft amendment for Texas trailing phlox (*Phlox nivalis* subspecies *texensis*) Recovery Plan (Recovery Plan) was available for public review, and to solicit comments by the scientific community, State and Federal agencies, Tribal governments, and other interested parties on the general information base, assumptions, and conclusions presented in the draft amendment. An electronic version of the draft recovery plan amendment was posted on the Service's Species Profile website:

<https://ecos.fws.gov/ecp0/profile/speciesProfile?sId=4462#recovery>

The Service did not receive any responses to the request for public comments.

Summary of Peer and Partner Review Comments

In accordance with the requirements of the Act, we solicited independent peer review of the draft amendment from qualified representatives from Federal and State agencies, as well as the academic and scientific communities including those from: Big Thicket National Preserve, Texas Department of Transportation, The Nature Conservancy, Stephen F. Austin State University, and two independent biologists. Peer reviews were conducted concurrent with the *Federal Register* publication. Criteria used for selecting peer reviewers included their demonstrated expertise and specialized knowledge related to: Texas trailing phlox, the ecology of the genus *Phlox*, population level ecology and dynamics, natural and prescribed burning, longleaf pine community, and/or familiarity with the Big Thicket area or Pineywoods ecoregion habitats of Texas. The qualifications of peer reviewers are in the decision file and administrative record for this Recovery Plan amendment.

In total, we solicited review and comment from six peer reviewers and one partner agency. Peer reviewers represented the Big Thicket National Preserve, Texas Department of Transportation, The Nature Conservancy, and Stephen F. Austin State University, but also included an independent biologist (retired), and a private forestry services biologist. None of our partner agency reviewers provided comments. In general, the draft amendment was well received by peer reviewers and garnered some positive comments. Several reviewers provided additional specific information, including documents to review. We thank the reviewers for these data and we have added the information, where appropriate.

We considered all substantive comments, and to the extent appropriate, incorporated the applicable information/suggested changes into the final Recovery Plan amendment. Below, we provide a summary of specific comments received from peer reviewers with our responses. Many specific editorial critiques/suggestions were incorporated as changes to the final amendment, but did not warrant an explicit response and are not addressed here. Additionally, a meeting was held on July 18, 2019, to allow for direct comments from partners working on the Texas trailing phlox and its' recovery. We appreciate the individual input from all commenters, which helped us to consider and incorporate the best available scientific and commercial information during development and approval of the final Recovery Plan amendment.

Peer Review Comment (1): The reviewer noted that in order to establish criteria for populations of Texas trailing phlox, a system must be developed to determine the current extent of the subspecies. Habitat is available, but the number of individuals/groups that are skilled in locating the subspecies is very limited. Priority areas can be identified for first time surveys using soil layers and aerial photography. Given the numerous acres of potential habitat, there are likely more populations that have not been identified.

Response: The Service completed a draft Species Status Assessment (SSA) for Texas trailing phlox in 2018, in which we describe the resource needs of the subspecies. Using the best scientific information available, the SSA defined the resource needs that should be used as the tool to delineate habitat and search for additional populations.

Peer Review Comment (2): The Texas Parks and Wildlife Department's Texas Natural Diversity Database (NDD) Element of Occurrence (EO) records for EO #9 need to be verified. Only a single plant was documented from this population in 1997, although the amendment refers to a much larger plant estimate. Additionally, naming conventions for EO records are not clear. The populations found on tracts under conservation easements with The Nature Conservancy were originally listed as Temple-Inland however Campbell Global was the manager of the lands followed by Temple-Inland. The actual ownership of lands is under Crown Point.

Response: We reviewed the Texas NDD (2014, p. 52). According to their records, the EO #9 from Tyler County was first observed in 1997. This population was described as having plants flowering, some with white corollas; however, a specific number of plants was not noted at the original time of observation and therefore, not included in our analysis discussion. However, in more recent searches, including one as recent as 2018, only a single plant was noted.

Regarding the naming conventions from the Texas NDD specific to our use of "Campbell Timber", we considered this comment and will now refer to this population as the "Timber Conservation Lands" in Hardin County. Since land ownership may change and thus cause more confusion in the future, we determined it most appropriate to provide a more general naming convention for this specific site.

Peer Review Comment (3): Two peer reviewers commented on the analysis and use of pollinators to help determine the population size for Texas trailing phlox. The reviewers questioned the use of pollinators and their average territory sizes and our application of this information in the analysis, and if other *Phlox nivalis* subspecies were hosts to certain pollinators.

Response: With regards to defining a population and the separation distance between each Texas trailing phlox population, the Service did consider surrogate species in our analyses. These surrogates were also pollinated by generalists and thus deemed inappropriate to draw conclusions to Texas trailing phlox and its' own pollinators/population distances. In addition to looking at surrogate species, the Service solicited expertise from the scientific community. One expert opinion suggests that the Eastern Tiger swallowtail butterfly (a known and recorded visitor to Texas trailing phlox) is a generalist pollinator in the Pineywoods habitat and therefore, is not likely to significantly contribute to the population structure (i.e. reproductive success and fitness)

of this subspecies. Other pollinators within the same habitat community may use Texas trailing phlox, but we lack scientific studies verifying these as effective pollinators. Therefore with the best scientific information, we determine that healthy population connectivity would allow for genetic and pollinator exchange and foraging; that exchange/foraging would occur within and between populations; and, that 2.0 kilometers (km) (1.2 miles (mi)) would be an appropriate distance for this exchange between populations to occur.

Peer Review Comment (4): One reviewer requested an explanation for how it was determined that 12 populations would provide a sufficient level of redundancy to downlist Texas trailing phlox.

Response: Texas trailing phlox is known from seven extant populations in Hardin, Polk, and Tyler counties thus the global range of the subspecies is geographically small and restricted. We speculate that historically more populations occurred on the landscape, connecting the existing extant populations, but with habitat alteration and modification, suitable habitat has been depleted or the plant has been directly affected. There are herbarium records of Texas trailing phlox that could indicate connectivity between extant sites in the past, however since most location information is vague, it has proven difficult to relocate these records. The measured distances between known populations are almost 66 km (41 mi) apart (RMS introduction - Tyler County and Campbell Easements – Polk County) between the furthest populations, with 2.2 km (1.36 mi) separating the closest distinct populations. We anticipate that populations exchange gene flow either through stochastic events such as extreme flooding or rain occurrences, and/or through pollinators. We assume that there is some connectivity between populations that provides the necessary breeding and foraging resources for pollinators of this subspecies. However, we lack definitive genetic information that could be used to describe the connectivity of these known populations and we lack information describing the effective pollinators, thus their relationship and reliance on Texas trailing phlox. Therefore, due to our lack of understanding at this time and no new information received during this comment period on the number of populations needed to provide resiliency to Texas trailing phlox, we will continue to defer to the initial downlisting criteria until more information is available.

Peer Review Comment (5): One reviewer requested clarification on how it was determined that 15 populations (an addition of three population to the downlisting criteria) is appropriate for delisting the Texas trailing phlox. The reviewer questioned if other data or other species in similar habitats were used to model this delisting estimate.

Response: We estimate that to secure redundancy into the foreseeable future for Texas trailing phlox, that additional populations (to the 12 populations needed for downlisting) will be needed across its' range. Since the subspecies is known only from a 3-county range, we estimate that it could be important to increase the redundancy of populations within each of those counties. However because we lack genetic information to describe the relatedness between and among extant populations, at this time we cannot describe how these populations should be distributed across the landscape. We met with experts on July 18, 2018, and requested individual feedback on the need of these three additional populations for delisting; no comments were received. At this time, the Service is not aware of a similar species that can be used to extrapolate identical population needs required to delist the subspecies.

Peer Review Comment (6): The delisting goal of 15 populations is appropriate however, increasing herbivory and threats from feral hogs may make this goal too low.

Response: Browsing by deer and other animals have been observed on the Texas trailing phlox (USFWS 1995, p. 10), but we do not have data that suggests that the level of threat is prominent to the subspecies at this time. We also lack observations of feral hogs impacting plants, however this does not preclude their presence on the landscape. Delisting criteria are based on the best scientific information to date. Should future threats include more frequent or intense herbivory and/or damage from feral hogs, the Service would revisit the criteria based on this new information.

Peer Review Comment (7): Two reviewers commented on assessing the impacts of climate change and the shifting of suitable habitat for the Texas trailing phlox. It was suggested that suitability mapping should account for modeling the shift of longleaf species as a result of climate change.

Response: Habitat suitability maps do not yet exist for this subspecies. For a discussion of the future scenarios of climate change and impacts to the Texas trailing phlox, please refer to the SSA document.

Peer Review Comment (8): One reviewer provided information on the subspecies longevity based on personal observations of the plant in the field from 1993 to 2019, as well as from other colleagues.

Response: This additional information supports the Service's estimates of a lifespan of the Texas trailing phlox to be at least 10 years, but at times could exceed these estimates. To reflect this new information, we made changes in the final amendment as appropriate.

Peer Review Comment (9): For monitoring of known Texas trailing phlox populations at the Big Thicket National Preserve, individual plants were previously defined as stems separated by 25 centimeters (cm). However, the definition of an individual plant was changed in 2017 to 3 cm. The change was made to reflect that most monitoring is of reintroduced populations, which were sometimes intentionally planted in close proximity, but most likely started out at separate plants. We concur with the current approach of using 5 decimeters to define individual plants for wild growing plants.

Response: We understand that individual plants should be defined differently when referring to a natural versus a reintroduced population. However, we lack the genetic information necessary to determine the relatedness of individuals within a population. Therefore, based on the best scientific information available to date we adhere to defining a plant by a separation distance by at least 5 m (1.6 feet). We will work with partners and agencies to ensure consistency when conducting surveys and how information is gathered/reported in the future. We anticipate updating our definition of a plant (and population) when the genetics of the subspecies is better understood.

Peer Review Comment (10): Two reviewers addressed the prioritization of habitat based on land ownership. One reviewer stated that private land should be considered when searching out new populations, but should not be the priority. Another reviewer stated that the focus should be on established public and private lands where protection and conservation are being carried out in perpetuity.

Response: Since so few populations are known and all are found within a small geographic range in Texas, the Service considers all extant Texas trailing phlox populations valuable to the recovery of the subspecies, regardless of its landownership. Extant Texas trailing phlox populations inhabit lands owned by a variety of entities including: the State (Texas Department of Transportation), the Federal government (Big Thicket National Preserve, U.S. National Park Service), and private entities (timber companies, The Nature Conservancy). With the State of Texas being almost entirely privately-owned coupled with several Texas trailing phlox populations occurring on private lands, we anticipate that these lands/landowners will continue to play an important role in recovering the subspecies should future supplementation efforts be deemed necessary. Reference to historical or unverified populations have been noted on Tribal lands and other state-owned properties, so future outreach and survey efforts should focus on these properties.

Peer Review Comment (11): It would be desirable for the Service to commit to annual participation in surveys for the subspecies due to limited personnel and resources of landowners/land managers at given locations to complete this work.

Response: The Service will continue to collaborate and proactively seek opportunities to conduct monitoring with landowners and land managers, as workload permits and as recovery efforts are needed for the subspecies.

Peer Review Comment (12): Two reviewers suggested future supplementation efforts to meet the minimum viable population goal of 600 plants per population, planning for future impacts from climate change, and securing a source for known provenance of plant material for new introductions and/or augmentations.

Response: In order to meet the minimum viable population goal of 600 plants per population, we recognize that future augmentations of populations may be necessary. We expect to continue collaborating with our partners, landowners, and land managers, as well as use the best scientific information available to determine the most successful and beneficial approach to meet this goal. If supplementation efforts are deemed necessary for the continued existence of the Texas trailing phlox, the Service will develop a species-specific Controlled Propagation and Reintroduction Plan. This plan will adhere to the Service's 2000 Controlled Propagation and Reintroduction Policy and address the following topics: identify the need for supplementation; identify key areas for placement (based on suitability mapping of the subspecies habitat needs, threats, genetics or other important resource needs or biology); outline logistics for supplementation efforts; determine the responsible parties to produce plants; establish timelines; and, address roles and responsibilities of those involved.

Peer Review Comment (13): One reviewer commented that there is recognition that the majority of locations for populations of this subspecies are not managed with a single species management plan. Management of the subspecies must be coordinated with many other resource concerns, goals, and objectives which contributes to additional challenges for the land manager.

Response: Since Texas trailing phlox populations are found in habitats that are owned and/or managed by diverse landowners, it will be important for these entities to develop and collaborate strategies that align with attaining optimal habitat quality conditions that promotes the recovery of Texas trailing phlox.