

**White Bladderpod**  
*(Physaria (=Lesquerella) pallida)*

**5-Year Review:  
Summary and Evaluation**



Photo Credit: Jason Singhurst TPWD

**U.S. Fish and Wildlife Service  
Coastal Ecological Services Field Office  
Houston, Texas**

**August 2014**

## **5-YEAR REVIEW**

### **White Bladderpod/*Physaria* (= *Lesquerella*) *pallida***

#### **1.0 GENERAL INFORMATION**

##### **1.1 Reviewers:**

**Lead Regional or Headquarters Office** Southwest Region, Region 2, Albuquerque, NM  
Susan Jacobsen, Chief, Division of Classification and Restoration, 505-248-6641  
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##### **1.2 Purpose of 5-Year Reviews:**

The U.S. Fish and Wildlife Service (Service) is required by section 4(c)(2) of the Endangered Species Act (Act) to conduct a status review of each listed species at least once every 5 years. The purpose of a 5-year review is to evaluate whether or not the species' status has changed since it was listed (or since the most recent 5-year review). Based on the 5-year review, we recommend whether the species should be removed from the list of endangered and threatened species, be changed in status from endangered to threatened, or be changed in status from threatened to endangered. Our original listing as endangered or threatened is based on the species' status considering the five threat factors described in section 4(a)(1) of the Act. These same five factors are considered in any subsequent reclassification or delisting decisions. In the 5-year review, we consider the best available scientific and commercial data on the species, and focus on new information available since the species was listed or last reviewed. If we recommend a change in listing status based on the results of the 5-year review, we must propose to do so through a separate rule-making process including public review and comment.

##### **1.3 Methodology used to complete the review:**

The public notice for this review was published in the Federal Register on March 29, 2010 (75 FR 15454). This review considers both new and previously existing information from Federal and State agencies, non-governmental organizations, academia, and the general public. Information used in the preparation of the review includes the Texas Parks and Wildlife Department (TPWD) Texas Natural Diversity Database (TXNDD), final reports of section 6-funded projects, monitoring reports, scientific publications, unpublished documents, personal communications from botanists familiar with the species, and Internet web sites. The 5-year review was prepared by personnel of the Coastal Ecological Services Field Office of the U.S. Fish and Wildlife Service (Service) without peer review.

## 1.4 Background:

White bladderpod (*Physaria* (= *Lesquerella*) *pallida*) was federally-listed as endangered without critical habitat on April 10, 1987 (52 CFR 7424). The State of Texas listed the species as endangered on May 18, 1987.

*Physaria* (= *Lesquerella*) *pallida* was listed under the scientific name *Lesquerella pallida*. Al-Shehbaz and O’Kane (2002) proposed that all the North American species in the genus *Lesquerella* (except the auriculate-leaved species) be placed in synonymy with *Physaria*. This 5-year review supports the change in scientific name and will use *Physaria pallida* as the preferred nomenclature throughout the remainder of this document. The decision to support the change is discussed in detail in section 2.3.1.4.

### 1.4.1 FR Notice citation announcing initiation of this review:

75 FR 15454, March 29, 2010.

### 1.4.2 Listing history

#### Original Listing

**FR notice:** 52 FR 7424.

**Date listed:** April 10, 1987.

**Entity listed:** *Lesquerella pallida* (white bladderpod).

**Classification:** Endangered without Critical Habitat.

### 1.4.3 Associated rulemakings: None.

**1.4.4 Review History:** The Service proposed listing white bladderpod as endangered on April 9, 1986 (51 FR 12184). The final rule designating white bladderpod as an endangered species published in the Federal Register March 11, 1987 (52 FR 7424) with an effective date of April 10, 1987. This is the first 5-year review conducted for this species. Other review documents that summarize the species and its habitat include:

- Status Report: Nixon 1984
- Status Report Update: Mahler 1985
- Section 6 Report E-1-4: Warnock 1992
- Final Recovery Plan, USFWS 1992

### 1.4.5 Species’ Recovery Priority Number at start of 5-year review: 2.

The species’ current Recovery Priority Number is 2, meaning that it is a full species with a high degree of threat and a high recovery potential.

### 1.4.6 Recovery Plan or Outline

**Name of plan or outline:** White Bladderpod Recovery Plan

**Date issued:** October 16, 1992

**Dates of previous revisions, if applicable:** Not applicable.

## 2.0 REVIEW ANALYSIS

### 2.1 Application of the 1996 Distinct Population Segment (DPS) policy

The Distinct Population Segment policy applies only to vertebrate animals.

### 2.2 Recovery Criteria

**2.2.1 Does the species have a final, approved recovery plan?** Yes.

**2.2.1.1 Does the recovery plan contain objective, measurable criteria?** Yes, for downlisting; recovery criteria have not yet been developed for delisting.

**2.2.2 Adequacy of recovery criteria.**

**2.2.2.1 Do the recovery criteria reflect the best available and most up-to date information on the biology of the species and its habitat?** No.

The Recovery Plan was published in 1992, prior to the discovery of 4 of the 10 populations now known. Additionally, scientific investigations completed since 1988 have greatly increased our knowledge of the management and ecology of *Physaria pallida*.

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

Delisting criteria have not yet been developed. However, the recovery plan does contain two recovery criteria that were developed for downlisting. These criteria are described below:

***Downlisting criterion 1:*** Establish or maintain 12 self-sustaining populations or metapopulations (i.e. small populations near enough together to function as a single population) of white bladderpod. For the purposes of this plan, a population will be considered self-sustaining if it reaches a population number of 1,000 plants and a density of 0.25 plants per square foot in at least one year of five continuous years. Because white bladderpod occurs in habitat islands or patches dispersed within a larger matrix of less suitable or nonhabitat, some sites may be too small to support 1,000 plants and thus should not be considered among the 12 self-sustaining populations. However, they could be part of a metapopulation. The numbers of plants in populations must be verified through monitoring.

***Downlisting criterion 2:*** Establish agreements for the protection and management of the 12 self-sustaining populations. Binding agreements are preferable because they will provide long-term management continuity, but non-binding agreements will be adequate to contribute to the objective of this plan.

**Discussion:** Ten wild populations of *P. pallida* have now been documented in San Augustine County, nine locations on private land and one on a state highway right-of-way, none of which can be considered fully protected. Numbers at each location are highly variable ranging from a couple of plants to over 3000. Only 2 of these populations have appeared to reach population numbers greater than 1,000 individuals as described in the downlisting criteria. However, the numbers have varied greatly from year to year and the current status of these populations is unknown. Additionally, one experimental reintroduction was attempted in 2009, but we have no information on the current status of that reintroduction. Due to decreased funding and staffing levels, surveys have not been completed on known populations since 2006, with some not surveyed since 2001.

The recovery plan includes the following outline of recovery actions. The actions that have been completed for all known locations are indicated with an asterisk (\*) in the list and in italics (*recovery action xxxx*) in the text of this review. Recovery action item 4 is currently ongoing. However, due to the length of time since several of these actions were completed, landowners or agency personnel may have changed and the actions may need to be repeated.

- 1.\* Contact the landowners and land managers of all *P. pallida* sites.
  - 1.1.\* Educate landowners about the significance of *P. pallida* and its protection under the Endangered Species Act.
  - 1.2.\* Inform state and county highway departments of the exact locality of plants on road right-of-ways.
- 2.\* Work with landowners to develop and implement management for the species.
  - 2.1.\* Determine landowner short-term and long-term land use goals and the effect on *P. pallida*.
  - 2.2.\* Develop and implement management plans that are beneficial to the species and acceptable to landowners.
  - 2.3.\* Develop simple but quantitative monitoring techniques to include in management plans.
  - 2.4. Encourage the establishment of stewardship agreements.
- 3.\* Manage plants on road right-of-way.
- 4.\* Enforce the rules and regulations of the Endangered Species Act and the Texas Parks and Wildlife Code.
- 5.\* Study the biology of *P. pallida*.
  - 5.1.\* Determine the soil seed bank and seed viability.
  - 5.2.\* Study germination and seedling establishment.
  - 5.3.\* Study fire, shading, competition, and grazing.
- 6.\* Search for new populations.
- 7.\* Establish a botanical garden population and seed bank.
- 8.\* After all potential habitat has been identified and surveyed, establish new populations in suitable sites if still needed to meet downlisting criteria.
  - 8.1.\* Search for potential introduction sites.
  - 8.2.\* Obtain permission from the landowner of land managing agency.
  - 8.3.\* Design introduction projects so their success can be quantitatively measured.

- 8.4. Monitor introduced populations.
- 9.\* Develop and implement a public awareness program.

**Recovery team:**

*Physaria pallida* does not have a recovery team.

**2.3 Updated Information and Current Species Status**

**2.3.1 Biology and Habitat**

**2.3.1.1 New information on the species' biology and life history:**

*Physaria pallida* is a member of the mustard family (Brassicaceae) found only in San Augustine County, Texas, on glauconite outcrops of the Weches glades in the east Texas Pineywoods of the West Gulf Coastal Plain physiographic province. Growing in clearings of alkaline soils within oak-hickory-pine forests, *P. pallida* is an annual plant, and reproduces by seed.

Warnock (1992) found that *P. pallida* normally germinates in November and December, and overwinters as a rosette. This study also found that germination in greenhouse plots was significantly better at 62.5% than 8.2% germination found in field plots. Greenhouse plants also grew at a significantly greater rate but it is unclear if the difference is due to unusual weather conditions in the field over the study period (Warnock 1992).

Turner (2001) found that *P. pallida* was most successful in relatively deep bare soils with sparse herbaceous ground cover. Closed forest canopy and deep litter layers are not conducive to *P. pallida* habitat. Turner (2001) also found that *P. pallida* is pollinated by a variety of small insects from the Diptera and Hymenoptera orders.

*Physaria* and *Lesquerella* species have been studied for commercial use due to their high hydroxy fatty acid content (Dierig et al. 1996; Dierig et al 2004; Salywon et al. 2005). Hydroxy fatty acids are employed for a variety of human uses including pharmaceuticals and cosmetics. Dierig (2004) found that *P. pallida* has one of the highest amounts of hydroxy fatty acid in its seed oil of any *Physaria* species.

**2.3.1.2 Abundance, population trends, demographic features, or demographic trends:**

Only six populations were known when the recovery plan was published (USFWS 1992). These populations were on privately owned land and a county road right-of-way, all in San Augustine County. Section 6-funded projects included surveys

resulting in three additional populations found. The fourth additional population was discovered in 2005 along a state highway right-of-way.

Since the recovery plan was published, landowners have restricted Service access to two of the original six sites, and monitoring at these two sites has ceased. At least one of these two sites appears to be directly adjacent to glauconite mining. Additionally, one of the original six sites was partially destroyed by a new pipeline right-of-way in 2010-2011. *Physaria pallida* was seen on this site in 2012 but no official survey was conducted (Singhurst 2012).

The TPWD manages the TXNDD. This database stores rare plant and animal spatial and tabular data submitted by Federal, State, academic, non-governmental organizations (NGOs), researchers, and consultants. TXNDD tracks 232 species including all federally listed plant species known to occur in Texas. These data are presented as element occurrences. “An Element Occurrence (EO) is an area of land and/or water in which a species or natural community is, or was, present” (NatureServe 2002). The most recent updates to the TXNDD information on *P. pallida* do not include data more recent than 2005.

Current species population status is unknown. The most recent surveys conducted were completed in 2005-2006 on only a few of the known locations. See Table 1 below for most recent EO data and survey results.

Table 1. Element occurrences for each known population of *P. pallida*.

EO #	Date Last Surveyed (# Plants)*	Low Count (Year)*	High Count (Year)*	Approximate Area	Notes
1	2006 (145)	9 (1988)	>5000 (1990)	6 acres	Partially destroyed by powerline 2010-2011
2	2001 (165)	0 (1987)	250 (1988)	2 acres	
3	2005 (0)	0 (1987)	935 (2000)	2 acres	
4	1996 (0)	0 (1996)	>4000 (1991)	10 acres	Adjacent to glauconite mine/ Loss of access/ population status unknown
5	1996 (0)	0 (1996)	>1000 (1988)	2 acres	Loss of access/ population status unknown
6	2006 (110)	2 (1998)	2000 (1994)	10 acres	
7	2006 (2)	2 (2006)	5767 (2000)	8 acres	
8	2001(1086)	280 (1998)	3160 (1999)	10 acres	
9	2006 (Thousands)	100 (1996)	9796 (2001)	2 acres	
SH 21 ROW	2009 (200)	Unknown	200 (2009)	>1 acre	Reviewed under formal section 7 consultation 21430-2009-F-0151
Introduction Site	Planted 2009	Unknown	Unknown	6 acres	Approximately 6 acres of privately owned land brush-hogged and planted.

\* Most counts are approximate.

Population counts vary greatly over time due to climatic variation and land use. Some populations have varied from 9 plants in one year to over 3,000 in the next growing season (TXNDD 2012). The latest surveys were conducted in 2005 and 2006 of most EO sites while climatic conditions were unfavorable to *P. pallida*.

#### **2.3.1.3 Genetics, genetic variation, or trends in genetic variation:**

To date, no genetic studies have been conducted on *P. pallida*.

#### **2.3.1.4 Taxonomic classification or changes in nomenclature:**

*Physaria pallida* was first described by Dr. M.C. Leavenworth in the 1830s and elevated to species rank as *Vesicaria pallida* (Torrey and Gray 1838). Watson (1888) established *Lesquerella* as a genus separate from *Vesicaria*, and *Vesicaria pallida* became *Lesquerella pallida*, the taxon with which it was listed under the Act. Al-Shehbaz and O’Kane (2002) found that the genus *Lesquerella* is indistinguishable from the genus *Physaria* in every morphological aspect except for *Physaria* having didymous, or paired, fruits and *Lesquerella* having non-didymous fruits. Additionally, molecular, distributional, and ecological data was strong enough to support the merging of *Lesquerella* into *Physaria* for all North American species of *Lesquerella* (Al-Shehbaz and O’Kane 2002). The Service supports this change in taxonomy to *Physaria pallida*.

#### **2.3.1.5 Spatial distribution, trends in spatial distribution, or historical range:**

The known number of populations has increased since the recovery plan was completed, but the current known range is still limited to the Weches Formation in San Augustine County, Texas, with historical range possibly reaching into Sabine County, Texas. *Physaria pallida* is endemic to the Weches glades. The Weches Formation is a roughly 50 million year old Eocene age marine sequence with outcroppings forming alkaline glades necessary for plant growth in an area of sandy acidic soils (Bureau of Economic Geology 1967).

#### **2.3.1.6 Habitat or ecosystem conditions:**

San Augustine County is 1,534 km<sup>2</sup> (592 mi<sup>2</sup>) in area and the 2010 census states the human population is 8,865, dropping by 0.9% from 2000 (US Census Bureau 2010). Major loss of habitat due to urban development is unlikely in the near future.

Glaucanite is an iron potassium phyllosilicate mineral (Odin 1988). Glaucanite is used in paint pigmentation, fertilizers, and most recently as road paving material. The Weches Formation is rich in glaucanite, making it a profitable mining location. Since the White Bladderpod Recovery Plan was published in 1992, San Augustine County has seen multiple open pit glaucanite mines arise on Weches

Formation outcrops. Glaucinite mining is likely to become a major threat to *P. pallida*.

The largest threat continues to be competition from woody vegetation. The McCartney rose, *Rosa bracteata*, is an invasive perennial shrub, introduced from Asia. It is a significant competitor on multiple sites and if left unattended can quickly overtake suitable habitat for *P. pallida*.

Warnock (1992) found that prescribed burning, most mechanical woody vegetation removal means, and pocket gopher activity all had positive effects on *P. pallida* production. Light to moderate grazing only delayed reproduction, but had little effect otherwise. Heavy grazing, pasture improvement, chemical and disking vegetation removal means, and several competing species had negative impacts on production. Production was measured as leaf number, plant height, bud number, flower number, and fruit number.

Several associated species were found during Warnock's study during the early 1990s. A total of 152 plant species were observed on the study site including *P. pallida*. Plants associated with *P. pallida* are listed in Table 2.

Table 2. Plant species associated with *P. pallida* (adapted from Warnock 1992).

<b>Genus</b>	<b>Species</b>	<b>Common Name</b>	<b>Negatively Correlated with growth</b>
<i>Aesculus</i>	<i>pavia</i>	Red buckeye	
<i>Allium</i>	<i>canadense</i>	Wild onion	
<i>Andropogon</i>	<i>virginicus</i>	Broomsedge bluestem	X
<i>Astragalus</i>	<i>leptocarpus</i>	Slimpod milkvetch	
<i>Bouteloua</i>	<i>curtipendula</i>	Sideoats grama	
<i>Cacalia</i>	<i>plantaginea</i>	Indian plantain	
<i>Calylophus</i>	<i>drummondii</i>	Yellow evening primrose	
<i>Chaerophyllum</i>	<i>tainturnieri</i>	Hairyfruit chervil	
<i>Dracopis</i>	<i>amplexicaulis</i>	Clasping coneflower	X
<i>Gaura</i>	<i>parviflora</i>	Small-flowered gaura	
<i>Geranium</i>	<i>caroliniaum</i>	Carolina geranium	
<i>Hedyotis</i>	<i>nigricans</i>	Diamondflowers	
<i>Ipomopsis</i>	<i>rubra</i>	Standing cypress	
<i>Lonicera</i>	<i>japonica</i>	Japanese honeysuckle	X
<i>Manfreda</i>	<i>virginica</i>	False aloe	
<i>Muhlenbergia</i>	<i>schreberi</i>	Nimblewill	
<i>Onosmodium</i>	<i>occidentale</i>	False-gromwell	
<i>Petalostemum</i>	<i>pulcherrimum</i>	Prairie clover	
<i>Physalis</i>	<i>viscosa</i>	Starhair groundcherry	
<i>Prunus</i>	<i>mexicana</i>	Mexican plum	
<i>Rosa</i>	<i>bracteata</i>	McCartney rose	X
<i>Rhus</i>	<i>glabra</i>	Smooth sumac	
<i>Rudbeckia</i>	<i>triloba</i>	Browneyed susan	
<i>Salvia</i>	<i>lyrata</i>	Lyreleaf sage	
<i>Sanicula</i>	<i>canadensis</i>	Canadian blacksnakeroot	
<i>Satureja</i>	<i>arkansana</i>	Arkansas savory	X
<i>Schizachyrium</i>	<i>scoparium</i>	Little bluestem	
<i>Sisyrinchium</i>	<i>langloisii</i>	Southern blue-eyed grass	X
<i>Sporobolus</i>	<i>asper</i>	Tall dropseed	
<i>Thelesperma</i>	<i>filifolia</i>	Stiff greenthread	
<i>Trifolium</i>	<i>dubium</i>	Small hop clover	X
<i>Viola</i>	<i>rafinesquii</i>	Field pansy	
<i>Vulpia</i>	<i>octoflora</i>	Common sixweeks grass	X
<i>Weissia</i>	<i>controversa</i>	Controversial weissia moss	X
<i>Yucca</i>	<i>arkansana</i>	Yucca	

### 2.3.1.7 Conservation Measures:

#### Section 7 consultations:

One formal section 7 consultation, 21430-2009-F-0151, has evaluated potential impacts to *P. pallida*. The project was found not to jeopardize the continued existence of the species. There were no impacts noted upon or subsequent to completion of the project on September 30, 2010 (Adams 2013).

#### Section 6 funded grants:

“The Cooperative Endangered Species Conservation Fund (section 6 of the Act) provides grants to States and Territories to participate in a wide array of voluntary conservation projects for candidate, proposed, and listed species. The program provides funding to States and Territories for species and habitat conservation actions on non-Federal lands” (USFWS 2012). TPWD and the Service have supported three section 6 grants in Texas that address *P. pallida* conservation and recovery, summarized in Table 3 (below).

Table 3. Section 6 grants involving *P. pallida*.

Job/Project	Date	Principal investigator	Project Title
6.1 , E-1-2	1991	David Diamond	Endangered and Threatened Species Conservation/ White Bladderpod Management
6.1 , E-1-3	1992	Lee Ann Johnson Linam	Endangered and Threatened Species Conservation/ White Bladderpod Management
6.1 , E-1-4	1992	Michael Warnock	Endangered and Threatened Species Conservation/ White Bladderpod Management

The objectives of Grant E-1-2 through E-1-4 were to conduct experiments to study the effects of shading, competition, grazing, fire, and other factors on growth of *P. pallida*.

Additionally, section 6 grant no. E-1 (Project WER71) contributed to the creation of Rare Plants of Texas (Poole et al. 2007), an invaluable compilation of data on 232 rare, threatened, and endangered plants of Texas, including *P. pallida*.

#### Contracts and Cooperative Agreements:

The Service has supported three cooperative agreements that involved *P. pallida*, summarized in Table 4 (below).

Table 4. Contracts and cooperative agreements involving *P. pallida*.

<b>Job/Project/ Grant no.</b>	<b>Date</b>	<b>Principal Investigator</b>	<b>Project Title</b>
14-16-0002-86-931	1989	Helen Ballew (Texas Nature Conservancy)	Landowner Contact Report on Endangered Plant Sites
14-48-0009-92-1020	1998	Peggy Olwell (Center for Plant Conservation [CPC])	Establishment and protection of permanent seed bank for the White Bladderpod ( <i>Lesquerella pallida</i> )
1448-20181-98-G943	2006	Rick Turner (The Nature Conservancy [TNC])	Status Survey, Site Protection, and Habitat Restoration for Texas Golden Gladecress ( <i>Leavenworthia texana</i> ), White Bladderpod ( <i>Lesquerella pallida</i> ), and Associated Glade Communities.

Agreement number 14-48-0009-92-1020 supported collection of seeds and establishment of seed banks at the Mercer Arboretum and the National Seed Storage Laboratory. Agreement number 1448-20181-98-G943 supported multiple years of surveys, seed collection, mapping habitat, land owner assistance, and completion of the Conservation Area Plan for the San Augustine Glades (TNC 2003).

**Public Outreach:**

Due to the high amount of private land in San Augustine County, landowner outreach is crucial to the recovery of *P. pallida*. Through Service funded cooperative agreements, The Nature Conservancy has informed landowners with potential habitat of the existence of the endangered plant and land management practices that enable conservation of *P. pallida*. These efforts were last done extensively in 2003 and ownership of those tracts may have changed since that time. Informal brochures were distributed in 2005 to landowners of potential habitat identified by a landscape analysis. Service staff has contacted landowners over the past two decades informing them of the existence of *P. Pallida* on their property and working with them to produce a land management plan beneficial for the listed plant. Short term conservation agreements have been signed by multiple land owners, but as of 2012 all have expired. The Conservation Area Plan for the San Augustine Glades (TNC 2003) was completed by TNC and circulated to landowners throughout San Augustine County.

### **Seed propagation:**

Through section 6 grants and cooperative agreements, seeds have been collected over the past two decades and stored in seed banks and captive populations at Mercer Arboretum and Botanic Gardens, the National Seed Storage Laboratory, and Pineywoods Native Plant Center. Mercer Arboretum has collected seeds from a majority of the *P. pallida* sites and houses a frozen seed bank as well as a captive population used for educational purposes. These seeds were collected by staff from Mercer Arboretum, TNC, TPWD, the Service, and the Center for Plant Conservation. The CPC co-operative agreement also collected seeds for storage in the National Seed Storage Laboratory run by the US Department of Agriculture in Fort Collins, CO. In 2001, approximately 3,979 seeds were collected by TNC and the Service for the purpose of propagation and seed storage by the Pineywoods Native Plant Center.

### **2.3.2 Five-Factor Analysis (threats, conservation measures, and regulatory mechanisms).**

The following potential threats to the conservation and recovery of *P. pallida*, described in the Recovery Plan (Service 1992), continue to impact the species at present:

- Invasion of woody and herbaceous plants (Factor A and E)
- Overgrazing (Factor A and C)
- Pasture improvement (herbicides, plowing, introduction of non-native grasses) (Factor A)
- Land conversion (Factor A)
- Rock quarrying (Factor A)
- Natural population fluctuation (Factor E)

Oil and gas activity has increased in San Augustine County recently, and threats now include habitat destruction from pipelines and oil and gas wells (Factors A and D). The newest discovered population is on a state highway right-of-way and can potentially be impacted by road maintenance (Factors A and D). *P. pallida* is also high in hydroxy fatty acids which are used commercially in cosmetics and pharmaceuticals (Factor B). Climate change (Factor E) is also an emerging threat.

#### **2.3.2.1 Present or threatened destruction, modification or curtailment of its habitat or range:**

One of the initial sites (EO #4) on private land is directly adjacent to a glauconite mine. The owners of this site as well as of another nearby site (EO#5) have denied access to these sites. It is unknown whether or not these two populations have been impacted by the mining activities. EO #1 was partially destroyed by a pipeline installation in 2010-11. Mining of glauconite in the vicinity of occupied and suitable moist, alkaline habitat remains a significant threat to *P. pallida*.

With the high population growth rate in Texas, land conversion is a constant threat for many listed species. However, San Augustine County, as discussed in 2.3.1.6, does not show the same growth rate as other counties in Texas, therefore we anticipate little loss from urban development.

Habitat conversion continues to be a threat in the form of pasture improvement. San Augustine is a relatively rural area with many family farms. Herbicide use and introduced grasses for the purpose of grazing remove viable habitat for *P. pallida*. Heavy grazing is also detrimental to *P. pallida*, and may prevent current populations from recruiting. Competition from woody vegetation is an ongoing and significant threat to *P. pallida*.

In summary, although the specific condition of populations and habitats on private land with limited access is not currently known, the degree of threats from habitat loss, degradation, and conversion continues to be moderate to high, with the highest threats from invasive plant competition, surface mining, and more recently from oil and gas development.

#### **2.3.2.2 Overutilization for commercial, recreational, scientific, or educational purposes:**

As discussed in 2.3.1.1, studies have shown that *P. pallida* is potentially a viable source for hydroxy fatty acids (Deirig 2004 et. al; Deirig 2004; Salywon et. al 2005). However, we have no documentation that *P. pallida* is being used to produce these acids for commercial use; thus overutilization is not considered a threat at this time.

#### **2.3.2.3 Disease or predation:**

We have no records of disease having adverse impacts to *P. pallida*.

Warnock (1992) noted that light to moderate grazing was beneficial to *P. pallida* and could potentially aid in the reduction of competing plants. Heavy grazing was found to be detrimental to the recruitment and growth of the species. The degree of heavy grazing upon *P. pallida* is unknown at this time, but does not appear to have extirpated any of the remaining 10 known populations/EOs.

#### **2.3.2.4 Inadequacy of existing regulatory mechanisms:**

The Act does provide some legal protection for federally-listed plants on federally owned lands, but federally-listed plants on privately owned lands have limited protection, unless they are protected by state laws as well. In this case, *P. pallida* is state-listed, but the State of Texas provides very little protection to listed plant species on privately owned land. All but one known population of *P. pallida* occur on privately owned land; therefore, few regulatory protections currently exist for this species.

Chapter 88 of the Texas Parks and Wildlife Code lists plant species as state-threatened or endangered once they are federally-listed as threatened or endangered. The State of Texas listed *P. pallida* as endangered on May 18, 1987. TPWD requires permits for the commercial use of listed plants collected from private lands and prohibits taking or possessing plants from public lands for commercial sale. Scientific permits are required for collection from public lands for educational or scientific purposes.

Without the protection of the Act, *P. pallida* would lack protections, particularly those addressing its habitat.

### **2.3.2.5 Other natural or manmade factors affecting its continued existence:**

According to the Intergovernmental Panel on Climate Change (IPCC) (2007) “Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level.” It is very likely that average Northern Hemisphere temperatures were higher during the second half of the 20th century than during any other 50-year period in the last 500 years; it is also likely that average temperatures during this period were the highest in at least the last 1,300 years (IPCC 2007). It is very likely that over the last 50 years, cold days, cold nights, and frosts have become less frequent over most land areas, and hot days and hot nights have become more frequent (IPCC 2007). It is likely that heat waves have become more frequent over most land areas, and also that the frequency of heavy precipitation events has increased over most areas (IPCC 2007).

The IPCC (2007) predicts that changes in the global climate system during the 21st century are very likely to be larger than those observed during the 20<sup>th</sup> century. For the next two decades a warming of about 0.2°C (0.4°F) per decade is projected (IPCC 2007). Afterwards, temperature projections increasingly depend on specific emission scenarios (IPCC 2007). The range of emission scenarios suggest that by the end of the 21st century, average global temperatures may increase from 0.6°C to 4.0°C (1.1°F to 7.2°F) with the greatest warming expected over land (IPCC 2007). Localized projections suggest that the southwestern U.S. may experience the greatest temperature increase of any area in the lower 48 States (IPCC 2007). The IPCC says it is very likely that hot extremes, heat waves, and heavy precipitation will increase in frequency (IPCC 2007). There is also high confidence that many semi-arid areas like the western United States will suffer a decrease in water resources due to climate change (IPCC 2007). Milly et al. (2005) project a 10 to 30 percent decrease in precipitation in mid-latitude western North America by the year 2050 based on an ensemble of 12 climate models.

*Physaria pallida* is susceptible to small scale variations in climatic levels. Early frosts and dry springs have been documented as possible reasons for high variability in population counts (Warnock 1992). Large scale variations such as those predicted by the IPCC could have dramatic effects on populations already on the decline due to other factors. As an edaphic (soil) specialist, *P. pallida* is confined to growing in alkaline sediments with unique mineral and water retention properties, a specialization that restricts the plant's capacity to spatially shift into surrounding, more acidic soils in response to changing climatic conditions. There is no way to accurately predict the level of effects that climate change will have on *P. pallida* and its habitat; however a continuing trend of warmer, drier, or less stable conditions could threaten the persistence of the plant. Adaptive management of the species is one strategy to deal with changing climate conditions.

## 2.4 Synthesis

*Physaria pallida* is an erect to spreading annual in the mustard family (Brassicaceae). Ten populations have been documented to date that vary greatly in population estimates from year to year; numbers of individuals in populations have ranged from single digits to over 3000 in a few populations under favorable conditions. The most recent surveys were conducted in 2005-2006, and do not represent a complete population survey. Current population status is unknown due to lack of funding. Three section 6 projects and three cooperative agreements have made up the majority of conservation and recovery work for *P. pallida*. The plant is endemic to the Weches Formation glades and with one exception is found only on privately owned lands. A majority of the land owners are cooperative and have managed for the species in previous years. One reintroduction was attempted in late 2009 on private land. It is too early to tell if this effort is successful in establishing a self-sustaining population and its current status is unknown. Threats continue as outlined in the Recovery Plan (USFWS 1992), with additional threats coming from oil and gas activities, surface mining of glauconite, and climate change, making *P. pallida* in danger of extinction throughout its narrow range into the foreseeable future.

## 3.0 RESULTS

### 3.1 Recommended Classification: Remain as Endangered

- Downlist to Threatened
- Uplist to Endangered
- Delist
  - Extinction
  - Recovery
  - Original data for classification in error
- No change is needed

### 3.2 New Recovery Priority Number: No change; remain as 2.

**Brief Rationale:** The current priority number is 2, which means that the taxon is a species that has a high degree of threat and a high recovery potential. The Weches Formation is under new threats in the form of surface mining and oil and gas activities. The current viable habitat is easily overcome by woody vegetation if not controlled through brush hogging and prescribed burns. Land owners in the past have been receptive to conservation of the species, but as lucrative opportunities arise in oil and gas, future land owners may not be as receptive.

#### **4.0 RECOMMENDATIONS FOR FUTURE ACTIONS**

- Revise the recovery plan to include new species information and threats while incorporating the most recent recovery planning guidance (National Marine Fisheries Service 2007).
- Continue monitoring and surveys of known populations.
- Implement section 6-funded projects, Service Partners for Fish and Wildlife Program projects, and cooperative agreements with state and federal agencies.
- Continue to search for additional populations.
- Continue reintroduction efforts. Implement a reintroduction program.
- Acquire new land owner conservation agreements with interested parties.
- Continue conservation and recovery awareness through public and landowner outreach.

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**U.S. FISH AND WILDLIFE SERVICE**  
**5-YEAR REVIEW of White Bladderpod (*Physaria* (=Lesquerella) pallida)**

**Current Classification:**

**Recommendation resulting from the 5-Year Review:**

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

**Appropriate Listing/Reclassification Priority Number, if applicable:** Not Applicable

**Review Conducted By:** Kelsey Gocke, Coastal Ecological Services Field Office  
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**FIELD OFFICE APPROVAL:**

**Lead Field Supervisor, U.S. Fish and Wildlife Service, Coastal Ecological Services Field Office, Houston, Texas**

Approve *Edith Epling* Date 8/16/2014

**REGIONAL OFFICE APPROVAL:**

**Assistant Regional Director, Ecological Services, U.S. Fish and Wildlife Service, Region 2**

Approve *Michelle Grayson* Date 8/26/14