Recovery Plan for *Lesquerella thamnophila* (Zapata bladderpod)

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DRAFT AMENDMENT 1

We have identified the best available information that indicates the need to amend recovery criteria for this species since the Zapata Bladderpod (*Lesquerella thamnophila*) Recovery Plan (Recovery Plan) was completed. In this proposed modification, we synthesize the adequacy of the existing recovery criteria, present amended recovery criteria, and the rationale supporting the proposed recovery plan modification. The proposed modifications are shown as an appendix that supplements the Recovery Plan, superseding only Reclassification Criteria in Section II Recovery Program (pp. 9-11) of the Recovery Plan (U.S. Fish and Wildlife Service (Service) 2004, pp. 9-11).

For
U.S. Fish and Wildlife Service
Southwest Region
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BACKGROUND INFORMATION

Recovery plans should be consulted frequently, used to initiate recovery activities, and updated as needed. A review of the recovery plan and its implementation may show that the plan is out of date or its usefulness is limited, and therefore warrants modification. Keeping recovery plans current ensures that the species benefits through timely, partner-coordinated implementation based on the best available information. The need for, and extent of, plan modifications will vary considerably among plans. Maintaining a useful and current recovery plan depends on the scope and complexity of the initial plan, the structure of the document, and the involvement of stakeholders.

An amendment involves a substantial rewrite of a portion of a recovery plan that changes any of the statutory elements. The need for an amendment may be triggered when, among other possibilities: (1) the current recovery plan is out of compliance with regard to statutory requirements; (2) new information has been identified, such as population-level threats to the species or previously unknown life history traits, that necessitates new or refined recovery actions and/or criteria; or (3) the current recovery plan is not achieving its objectives. The

amendment replaces only that specific portion of the recovery plan, supplementing the existing recovery plan, but not completely replacing it. An amendment may be most appropriate if significant plan improvements are needed, but resources are too scarce to accomplish a full recovery plan revision in a short time.

Although it would be inappropriate for an amendment to include changes in the recovery program that contradict the approved recovery plan, it could incorporate study findings that enhance the scientific basis of the plan, or that reduce uncertainties as to the life history, threats, or species' response to management. An amendment could serve a critical function while awaiting a revised recovery plan by: (1) refining and/or prioritizing recovery actions that need to be emphasized, (2) refining recovery criteria, or (3) adding a species to a multispecies or ecosystem plan. An amendment can, therefore, efficiently balance resources spent on modifying a plan against those spent on managing implementation of ongoing recovery actions.

METHODOLOGY USED TO COMPLETE THE RECOVERY PLAN AMENDMENT

The Zapata bladderpod's 2015 Five-Year status review (hereafter referred to as the 5-year review) (Service 2015, entire) was used as a foundation document for amending the Recovery Plan because it is a recent comprehensive analysis of all information known about this species through the time period ending in 2015. To determine if new information had become available since completion of the 5-year review, inquiries were made with other Service staff (Lower Rio Grande Valley National Wildlife Refuge) and external partners regarding monitoring, research projects, botanical garden seed storage or germination, or other efforts that may have been undertaken between 2015 and June 2018. Additionally, Service files were reviewed and online searches were conducted for journal articles and other information that has become available since 2015.

In addition to information review, the Service relied on the South Texas Plant Recovery Team (STPRT) for assistance in modifying recovery criteria for the Recovery Plan. The STPRT was formed in 2010 to oversee the recovery of nine species of listed plants in South Texas, including Zapata bladderpod. On June 12 and13, 2018, the STPRT met at Santa Ana National Wildlife Refuge to develop proposed recovery criteria revisions for the Zapata bladderpod and two other listed plant species. Seven team members, including two private citizen botanists, three academic botanists, a Texas Parks and Wildlife Department (State) botanist, and a Service plant ecologist. Nine other Service employees were also in attendance, including the liaison to the recovery team (the Service's Texas State Botanist), the species lead for the three plants, and National Wildlife Refuge and Ecological Services Program staff. The decision-making process relied upon open discussion among all members, led by the species' lead and the Texas State Botanist. The discussion was guided by an agenda with stated objectives. Additional information provided included Google Earth files showing known population or metapopulation locations, and handouts of species information, existing criteria, and Endangered Species Act definitions. Following the meeting, Service biologists corresponded with all team members (including members who were unable to attend the meeting in person) via email to solicit review and comments on meeting notes and tables displaying existing versus proposed criteria (South Texas Plant Recovery Team 2018, unpaginated). The proposed recovery criteria amendments will require formal peer review due to the modification of the original down-listing criteria and

the establishment of new de-listing criteria where none had existed in the original Recovery Plan. By using the STPRT, the Service was able to inform the State, some non-governmental organizations, and some members of the private sector about the proposal to revise recovery criteria.

ADEQUACY OF RECOVERY CRITERIA

Section 4(f)(1)(B)(ii) of the Endangered Species Act (Act) 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) also have affirmed the need to frame recovery criteria in terms of threats assessed under the five delisting factors.

Recovery Criteria

The original Recovery Plan defined criteria for reclassification to threatened, but did not include criteria for de-listing (see previous version of criteria in the 2004 Recovery Plan on pages 9-11). The first recovery goal for the species was to identify and achieve the conservation measures necessary to reclassify it from endangered to threatened, but the Recovery Plan stated that the restricted distribution of the species and the limited understanding of its life history and habitat requirements made it difficult to develop objective and measureable criteria that would lead to delisting. Therefore, a second recovery goal was developed to identify and obtain the information needed to determine delisting criteria for incorporation into revisions of the Recovery Plan. For this recovery criteria revision, certain aspects of Zapata bladderpod's life history and ecology, clarified by demographic and ecological monitoring conducted after 2004, were useful in refining downlisting criteria as well developing criteria to delist the species.

The Recovery Plan defined criteria for down-listing only. The first of two recovery criteria contained measurable attributes of 12 populations consisting of 2,000 reproductive individuals per population. The second criterion required establishment of agreements for protection and management of these populations.

Synthesis

Since development of the Recovery Plan, surveys in Mexico and Texas produced records of new populations thereby dramatically expanding the species' geographic range to the south. The most complete recent surveys, in 2007, documented eight extant populations and two additional populations of unknown status in Texas. Of the eight, four have had maximum population counts of at least 2,000 individuals. Although four populations are considered protected, only two of these have had greater than 2,000 plants counted, therefore two populations met the requirements of both criteria as of 2015 (Service 2015, p. 5). However, subsequent genetic analysis showed that the Mexican populations in the Loreto Sand Plain, formerly believed to be *P. thamnophila*, were instead more closely related to another Mexican *Physaria* species (Pepper 2006, Pepper 2008 in Service 2015, p. 18). Although the occurrence of suitable geology and soils in Mexico south of the existing Texas populations suggests that there is a possibility for the species to occur there, there are no records of the species in that part of Mexico either (Service 2015, p. 18). The lack of *P. thamnophila* occurrences in Mexico contracts the known native

range, narrowing its distribution to Zapata and Starr counties, Texas. Refined mapping of population locations and field observations showed Zapata bladderpod to be a narrow geoendemic, occurring only on soils overlying Eocene sandstone of the Laredo, Yegua, and Jackson formations. All the known populations occur in extremely friable, yellowish, sandy, often gravelly soil overlying sandstone, often just down-slope from overlying strata of fossil oyster shell. The porous shell strata perched above impermeable sandstone may create seepage zones that concentrate gypsum through evaporation from the soil surface (Service 2015, p. 7). The bladderpod's tight association with these soils and geology, in conjunction with its position on the landscape (affiliation with fossil oyster strata), further circumscribes, and helps to illustrate, the limited areal extent of the species' known range.

The 2015 5-year review recommended revising recovery criteria to reflect new information on the species' ecology as well as to meet new recovery guidance from the National Marine Fisheries Service and the U.S. Fish and Wildlife Service (Service 2015, p. 4). The new information resulted in a status review recommendation that the Recovery Priority Number for Zapata bladderpod be changed from 5C to 8C to reflect moderate threats and a higher recovery potential than was known when the Recovery Plan was written (Service 2015, p. 31). The 5-year review also recommended revision of the Recovery Plan to refine down-listing criteria and develop de-listing criteria.

Of note is the scientific name change for Zapata bladderpod (*Lesquerella thamnophila*) from the 2004 Recovery Plan) to the 2015 5-year review (*Physaria thamnophila* (Rollins and E.A. Shaw) O'Kane and Al-Shehbaz (Synonym: *Lesquerella thamnophila* Rollins and E.A. Shaw)). This name change reflects a taxonomic revision that is widely supported (Service 2015, p. 22).

Threats and Conservation Measures

The Recovery Plan included a five-factor threats analysis for the Zapata bladderpod based on information outlined in the listing rule as well as information obtained prior to 2004. Control of these threats was implicitly addressed in the recovery criteria and management recommendations were described (Service 2004, pp. 9-11). The 2004 analysis included threats from habitat destruction or degradation due to invasive non-native grasses (particularly buffelgrass (*Pennisetum ciliare*) and Kleberg bluestem (*Dichanthium annulatum*)), conversion of native vegetative cover to improved pasture, urban development, highway and utility construction in highway right-of-ways (ROW's), and oil and gas exploration and production. Additional threats included predation (wildlife browsing or cattle grazing); lack of regulatory protection for populations on privately-owned land; and potential for direct and indirect impacts from highway (ROW) maintenance including herbicide damage, and potential genetic drift induced by low population sizes during drought years (Service 2004, pp. 6-8).

The 5-year review reanalyzed threats to the species identified in the listing rule, as well as documenting new stressors, using information that became available between 2004 and 2015. The potential for habitat destruction and degradation from all the causes listed above continues to exist with the exception of the high level of threat associated with invasive grasses. Urban and commercial development listed in the Recovery Plan has continued throughout the region and a number of Zapata bladderpod populations are located in a zone of expanding development,

between the Rio Grande and Highway 83, the major NW-SE transportation artery in this region. Petroleum extraction and energy pipeline construction continues throughout the region (Service 2015, p. 26) and installation of wind turbines in Starr County has been rapidly increasing (N. Elizondo, Starr County Industrial Foundation pers. comm. 2018). Border security measures such as proposed border wall construction, and vehicle and foot traffic, also continue across the South Texas counties adjacent to the Rio Grande, including on national wildlife refuge tracts, potentially putting some of the existing bladderpod populations at risk of impacts because they are located in close proximity to the river.

The 5-year review analysis concluded that invasive grasses are not a high level threat in ***undisturbed*** bladderpod habitat. The close association with gypseous soils that overlie sandstone may be beneficial for the bladderpod by limiting invasion of non-native grasses. Although Zapata bladderpod's federal listing (64 FR 63745) included buffelgrass (*Pennisetum ciliare*) and Old World bluestems as characteristic members of bladderpod's habitat, vegetative analysis carried out by Fowler et al (2011) and Price et al (2012) showed these invasive grasses to be uncommon-to-entirely absent in undisturbed bladderpod populations (in Service 2015, p. 8). Because these invasive grasses constitute a growing menace for many rare plants and plant communities in South Texas, it is notable that pristine, undisturbed bladderpod habitat does not contain much evidence of these invasive species. This information helps to alleviate a perceived threat to bladderpod and eliminates the need to carry out invasive grass control at population sites where the ground has not been disturbed. The 5-year review indicates that buffelgrass is primarily a secondary threat that becomes problematic following soil disturbance in bladderpod habitat (Service 2015, p. 25).

Monitoring work and observations at Zapata bladderpod population sites between 2004 and 2015 elevated the level of threat to habitat and individual plants that arises from its underlying soils being inherently prone to erosion. The high gypsum content in soils at Zapata bladderpod sites may contribute to low soil cohesion (FAO 2015) (Service 2015, p. 25). A host of activities can initiate and exacerbate this erosion, including most forms of soil disturbance. Soil erosion can be associated with root-plowing (land cover conversion), overgrazing, foot traffic and all types of vehicle traffic, including all-terrain vehicles (ATVs). For example, damage to bladderpod plants and habitat has been observed on refuge tracts from vehicle and foot traffic associated with border security activities (Winton 2012 in Service 2015, p. 26). Rapid sheet erosion within population sites where leaf litter is sparse can also impede seedling establishment (Fowler et al 2011,; Price et al. 2012, in Service 2015, p. 8). Erosion also increases following construction within or adjacent to populations. "Soil lost to erosion cannot be reclaimed on these sites and the damage is permanent, so erosion is now recognized as a serious threat to the species and its habitat" (Service 2015, p. 30). Management to effectively deal with erosion may involve prohibiting vehicle traffic from crossing habitat and limiting foot traffic to the greatest degree possible, especially along slopes (Service 2015, p. 25). Additional conservation measures include controlling erosion during construction, practicing good rangeland management (avoiding grazing, especially overstocking, during drought), and controlling brush with non-soil disturbing methods (Service 2015, p. 9).

AMENDED RECOVERY CRITERIA

Recovery criteria serve as objective, measurable guidelines to assist in determining when an endangered species has recovered to the point that it may be downlisted to threatened, or that the Zapata bladderpod no longer meets the definition of either an endangered or threatened species and may be delisted. Delisting is the removal of a species from the Federal Lists of Endangered and Threatened Wildlife and Plants. Downlisting is the reclassification of a species from endangered to threatened. The term "endangered species" means any species (species, sub-species, or DPS) which is in danger of extinction throughout all or a significant portion of tis range. The term "threatened species" means any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

We provide downlisting criteria for the Zapata bladderpod which will supersede those included in the Recovery Plan (Service 2004: 9-11), and introduce delisting criteria for the species as follows:

Downlisting Recovery Criteria

Current recovery criteria

1. Maintain or establish 12 fully protected, geographically distinct, self-sustaining populations of the Zapata bladderpod within the historical and geographical range of the species in the United States: Each population should consist of at least 2,000 reproductive individuals at a size class structure reflecting that plants are reproducing and becoming naturally established within the population. These populations can be composed of smaller subpopulations so that the units function as one large meta-population if habitat availability is limited or fragmented and life history information support a meta-population structure. Distance between (meta) populations should be determined as information on genetics, seed dispersal and pollination is gathered throughout the recovery process. For populations to count toward the reclassification criteria, the number of plants, number of reproductive individuals, and age class structure must be verified through monitoring, including an assessment of the general habitat condition. Reintroductions, if necessary, can occur on Federal or State land, and/or private land that have been voluntarily entered into a stewardship agreement for the Zapata bladderpod by its owners. Threats to the species must be managed and controlled at each site.

2. Establish agreements for the protection and management of the 12 self-sustaining populations: Although binding agreements such as an approved management plan (e.g., National Wildlife Refuge Comprehensive Conservation Plan), or formal stewardship agreement with private landowners are preferable due to the commitment of long-term management continuity, non-binding verbal agreements can contribute in the interim to the objectives of this Recovery Plan. Protection and management measures for any populations on public land should be fully incorporated into Federal and State management plans.

Amended recovery criteria

1. Maintain or establish 12 geographically distinct, self-sustaining populations located within the species' historical range in the United States, with at least one population in each of the 3 geologic formations from which the species is currently known to occur. Each population should consist of at least 2,000 reproductive individuals (have flowered at least once or are capable of flowering) as determined during years when precipitation patterns have stimulated growth and reproduction. The numbers of reproductive individuals at each of the 12 population sites must be stable or increasing.
   Justification: Because Zapata bladderpod is a narrow endemic plant with a limited range, having multiple, geographically distinct populations increases the species' redundancy and thus its ability to withstand catastrophic events such as drought or floods. The justification for twelve Zapata bladderpod populations is based upon the following: (a) the understanding that this number reflects sufficient population repetition such that extinction is not likely in the foreseeable future; (b) retaining twelve populations as the target for reclassification increases species redundancy beyond existing levels (eight extant populations) and represents a significant increase in species redundancy from when the species was listed (four known sites); and (c) it is a feasible target considering the amount of unsurveyed range and the opportunity for reintroduction on Federal, State, and participating private land sites.

   The population location requirement within the species' historical range in the U.S., with at least one population in each of the three geologic formations from which the species is known to currently occur, attempts to maintain the highest possible level of representation in this species (South Texas Plant Recovery Team 2018, unpaginated). Zapata bladderpod's distribution is so restricted that it has a low level of representation in terms of geographic, ecological, or niche diversity, with few differences in ecological settings across its range except the underlying geologic foundation and soils.

   The recommendation for population size of 2,000 individuals of Zapata bladderpod is based on the concept that a minimum viable population (MVP) should maintain enough individuals that there is a 95 percent probability that the population will remain viable over a period of one-hundred years (Mace and Lande 1991). MVP size for the Zapata bladderpod should take into account the life characteristics of the plant, the extent of appropriate habitat, and threats to the species. Characteristics of the plant that should be examined include the life habit, breeding system, growth form, fecundity, ramet production (if any), survivorship, seed duration, environmental variation, and successional status (Pavlik 1996). According to these population characterizations, and available information on Zapata bladderpod, MVP for the plant requires a population size of approximately 2,000 reproductive individuals.

   "Maintain or establish" in criteria (1) should be interpreted to mean that the populations necessary for reclassifying the species to threatened can include currently existing, newly discovered, or reintroduced populations. Populations discovered on Federal, State, or private land that fit the definition of a MVP that can be protected with adequate management and monitoring programs (i.e., "maintain"), may count towards reclassification criteria. Efforts to reintroduce (i.e., "establish") Zapata bladderpod should be pursued as a method to reach reclassification as well as to provide sites available for research activities. It is recommended

that survey efforts for the species be intensified before large-scale reintroduction efforts take place. Protection (and augmentation, if necessary) of currently existing and newly discovered populations may be the most cost efficient method to recover the species. The recovery program will greatly benefit from continued and increased collaboration and cooperation between all partners, including private landowners.

If propagation and reintroduction of Zapata bladderpod is proven to be possible, this technique can take place as necessary, on Federal, State, and private land with consent of landowner. For example, reintroductions could take place on LRGV refuge tracts (e.g. Cuellar, Arroyo Morteros, and Arroyo Ramirez). Partnership and stewardship agreements to manage and protect or reintroduce the species should be pursued with interested parties. It is recommended that populations be geographically distinct from one another (depending on relevant life history information such as on pollinator range or genetic variability) to decrease the likelihood that localized events will impact more than one population.

2. To count toward reclassification, all populations must be appropriately protected and actively managed to reduce or eliminate threats to the species. Agreements for the protection and appropriate management of the 12 self-sustaining populations must be in place. Perpetual protection on public land will be assured via Service-approved management plans (e.g. National Wildlife Refuge Comprehensive Conservation Plans). Formal stewardship agreements (e.g. conservation easements or similar instruments) must be in place to ensure perpetual long-term, species-appropriate management on privately-owned land.

   Justification: The definition of *"fully protected"* sites includes management of populations on Federal or State lands as part of an approved management plan (e.g., National Wildlife Refuge Comprehensive Co Conservation Plans; State highway management agreements for right-of-way populations), or formal stewardship agreements for private landowners that include management and monitoring of the populations and habitat. Management must include measures to reduce or alleviate relevant threats to Zapata bladderpod (Service 2004, p. 10), including new threats identified in the most recent 5-year review. Once bladderpod pollinators have been identified, protection of the pollinators themselves and their habitat will also be important (South Texas Plant Recovery Team 2018, unpaginated).

Delisting Recovery Criteria

<u>Current recovery criteria</u>

None

<u>Amended recovery criteria</u>

1. Over a 30-year period following reclassification of the species to threatened, monitoring of 12 fully protected, self-sustaining populations consisting of at least 2,000 reproductive individuals per population shows that the populations are stable or increasing. These populations will be located within the species' historical range in the United States, with at

least one population in each of the three geologic formations from which the species is currently known to occur.

Justification: To be considered for de-listing, this stable-to-increasing trend continues at all populations for three additional 10-year cycles (30 total years). Because Zapata bladderpod population size, as well as the species' persistence, is closely associated with cycles of precipitation and drought, we stipulated monitoring over 10-year cycles that include drought and rainfall peaks in the de-listing recovery criterion. The 30-year period will allow detection of demographic trends that include the effects of climate (South Texas Plant Recovery Team 2018, unpaginated). This climate-based, 10-year cycle was calculated using National Centers for Environmental Information data from seven stations located between McAllen and Laredo, Texas (https://www.ncdc.noaa.gov/cdo-web/datatools/findstation 2018).

2. Populations continue to be protected through perpetual management agreements. Threats to each population have been reduced or eliminated through appropriate site management that may include such actions as limiting erosion by excluding vehicles, foot traffic, and/or overgrazing by livestock, diminishing woody vegetation using means that do not disturb the soil, or potentially controlling invasion by non-native grasses. The effectiveness of this management would be determined by monitoring the condition of habitat and the status of the species' such that it is stable or increasing in number.

   Justification: Populations must continue to be protected by perpetual agreements and show evidence that threats have been eliminated or controlled (South Texas Plant Recovery Team 2018, unpaginated). Monitoring of habitat and species condition at each site will show that threats previously documented at each site have been either eradicated or are under control. Strategies will be developed to deal with any new threats that become evident during the 30-year monitoring period. Effectiveness of habitat management strategy will be judged based on the condition of the species.

All classification decisions consider the following five factors: (1) is there a present or threatened destruction, modification, or curtailment of the species' habitat or range; (2) is the species subject to overutilization for commercial, recreational scientific or educational purposes; (3) is disease or predation a factor; (4) are there inadequate existing regulatory mechanisms in place outside the ESA (taking into account the efforts by states and other organizations to protect the species or habitat); and (5) are other natural or manmade factors affecting its continued existence. When delisting or downlisting a species, we first propose the action in the *Federal Register* and seek public comment and peer review. Our final decision is announced in the *Federal Register*.

Rationale

Recovery Citerion 1 was changed to stipulate that populations would be located within the species' historic range, with at least one population in each of the three geologic formations from which it is currently known. Because geologic formation names are occasionally lumped or split, conditional language was included to refer to the formations as these are currently designated (in 2018) (South Texas Plant Recovery Team 2018, unpaginated). The small areal

extent of the range also implies limited environmental variation between populations, potentially limiting the species ability to adapt to change. Information on reproductive biology, including pollinators, and potential genetic exchange between populations continues to be a gap in knowledge for the species, so we have no information on genetic exchange between populations (Service 2015, pp. 27-28).

The maintenance or establishment of 12 populations remains the same in the new criteria as in the original Recovery Plan. In the Recovery Plan the target number of populations was based on achieving a significant increase in the number of known populations from the time of listing (n=4), as well as the feasibility of finding or creating new populations due to the amount of potential habitat that had not yet been surveyed and opportunities for reintroduction (Service 2004, pp. 9-10). The STPRT indicated support for retaining 12 populations as the target for reclassification and delisting for the reasons listed above as well as to help increase redundancy beyond existing levels (eight extant populations) (South Texas Plant Recovery Team 2018, unpaginated). The 2015 5-year review also corrected the number of documented occurrences of bladderpod in the Recovery Plan which listed 11 known sites of which seven were extant at the time the plan was written. The Texas Natural Diversity Database's (TXNDD) Element of Occurrence (EO) data lists eight extant populations and two historic occurrences of unknown status (Service 2015, p. 15) for a total of 10. All known populations, both historic and extant, occur in the two-county area in Texas within a polygon that is approximately 57.3 km (35.6 miles) from north to south, and at its widest point on the east-west axis (furthest distance from the Rio Grande) measuring only approximately 9.7 km (6 miles). The area circumscribed by the population locations encompasses only approximately 59,000 hectares (145,000 acres). Because Zapata bladderpod is a narrow geologic endemic species with such a limited geographic range, all populations are likely to be affected similarly by factors such as extreme weather variations such as drought or deluges (Service 2015, p. 18).

In this amendment, the Zapata bladderpod's demographic criteria from the Recovery Plan are upheld in part, although specifications of size class structure are discarded. The Zapata bladderpod's recovery criterion 1 used a minimum viable population (MVP) target of 2,000 reproductive individuals; a number that was acknowledged in the 2015 status review (Service 2015, p. 17) and by the STPRT (South Texas Plant Recovery Team 2018, unpaginated) as reasonable for this species based on what was known of bladderpod's life history and calculated according to Pavlik's guidelines (Pavlik 1996, p. 137). Achieving this MVP will help the species maintain resilience within each population and this number of individuals remains the same in the revised criteria for down-listing as well as for de-listing.

Due to the species' widely fluctuating plant counts, the STPRT believed there is a need to determine population size over a span of years such that it would include drought that can induce dormancy and favorable rainfall patterns that induce reproductive activity, recruitment, and survival (South Texas Plant Recovery Team 2018, unpaginated). To be considered for reclassification to threatened, all 12 populations are stable to increasing at or over the base number of 2,000 reproductive individuals, as determined by monitoring carried out during years of favorable rainfall patterns so that reproductively active plants can be detected. Additionally, monitoring has shown that threats are controlled or eliminated at each population site, and all populations are in a protected status.

Conditional language from the original recovery criterion, stipulating the 2,000 reproductive individuals compose a size class structure that showed the species to be reproducing and becoming naturally established within the population, was eliminated from Criterion 1. This deletion was based on field work carried out by Sternberg (2005 in Service 2015, pp. 17), Fowler et al. (2011, p. 349), and Price et al. (2012, p. 6) that showed wide annual fluctuations in population size at the same sites and correlated this to rainfall patterns. This work also indicated that mass germination events produced large numbers of seedlings but that many never recruited into the populations due to mortality during hot, dry weather. Although the species is a perennial, the woody stem and root (caudex) may become dormant during extreme dry periods, making the plant difficult or impossible to find in the field (Service 2015, p. 17). Plant counts at any given site during/following unfavorable weather conditions could result in misleading conclusions regarding the population's size. Therefore, the recovery criterion was changed to reflect measurement of population size and stability from counts of individual reproductive plants only with no size class structure requirement. By counting only reproducing plants, we are using plants that have demonstrated survival and establishment as perennials.

In addition to a lack of knowledge of reproductive connectivity between existing populations, uncertainties also remain regarding the life span, the role of dormancy in surviving drought conditions, and the viability of the seed bank. The STPRT stressed the need to investigate these life history aspects in order to further refine recovery criteria. Knowledge of generation time and seed bank viability would help to validate or potentially change the monitoring time period needed to show that the species is stable or increasing in its natural habitat (South Texas Plant Recovery Team 2018, unpaginated). The Recovery Plan already includes recovery actions that would fill these information gaps through studies of the Zapata bladderpod's biology, including demographic analysis (3.2.1), phenology (3.2.2), seed production and dispersal (3.2.4), pollinator biology (3.2.3), and population genetics (3.2.6) (Service 2004, pp. 18-19).

Criterion 2 in the Recovery Plan required establishment of agreements for protection and management of the populations described in Criterion 1. The only change to this second criterion is inclusion of the notion that agreements need to be perpetual. Although voluntary agreements were indicated in the Recovery Plan as acceptable in the interim (for down-listing), the STPRT indicated support for a more permanent level of protection for the 12 populations. The new de-listing criteria stipulate permanent protection as well (South Texas Plant Recovery Team 2018, unpaginated).

Additional support for a 10-year timeframe for monitoring may also be inferred from Fowler et al. (2011, p. 350) which indicated the wide fluctuations in population size among years meant that judgement regarding success or failure of management practices should not be based on results after one to two years, but instead that a 10-year evaluation period would be more appropriate.

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