DEBEQUE PHACELIA
(*Phacelia submutica)*
RECOVERY PLAN

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U.S. Fish and Wildlife Service
Mountain-Prairie Region
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Deputy Regional Director, U.S. Fish and Wildlife Service

RECOVERY PLAN FOR DEBEQUE PHACELIA

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RECOVERY PLAN FOR DEBEQUE PHACELIA

I. INTRODUCTION

DeBeque phacelia (*Phacelia submutica*) is a rare annual narrow endemic forb found on clay soils of the Wasatch Formation in Mesa and Garfield Counties, Colorado. On, August 26, 2011, the U.S. Fish and Wildlife Service (Service) listed the species as threatened under the Endangered Species Act (Act) (July 27, 2011; 76 FR 45054) and designated critical habitat on September 12, 2012 (August 13, 2012; 77 FR 48368). We finalized a recovery outline in 2013 to guide recovery efforts and inform consultation and permitting activities until a comprehensive recovery plan for the species was approved (Service 2013, entire). On August 26, 2022, we completed a 5-year status review, which recommended that DeBeque phacelia maintain its status as a threatened species under the Act. On December 13, 2023, we announced a notice of availability of a draft recovery plan for DeBeque phacelia. During the 60-day public comment period, we received only minor editorial suggestions or recommendations for clarification and no substantive comments on the draft recovery plan, as summarized in Appendix A.

We conducted a species status assessment (SSA) for DeBeque phacelia and documented our analysis in an SSA report (Service 2022, entire), which is an in-depth, scientific review of the species' biology and threats, an evaluation of its biological status, and an assessment of the resources and conditions needed to maintain populations over time. In our SSA, we identified individual, population, and species requirements, or needs, and the factors affecting the species' survival. We then evaluated the species' current and future condition to assess the species' current and future viability in terms of its resiliency, redundancy, and representation (the 3Rs). Resiliency is the ability of populations to sustain in the face of stochastic events, or for populations to recover from years with low reproduction or reduced survival, and is associated with population size, growth rate, and the quality and quantity of habitats. Redundancy is the ability of the species to withstand catastrophic events, for which adaptation is unlikely, and is associated with the number and distribution of resilient populations. Representation is the ability of a species to adapt to changes in the environment and is associated with its diversity, whether ecological, genetic, behavioral, or morphological.

To discern the nuances in conditions that occur across the range of the species and in the stressors that are influencing these conditions, we analyzed the resiliency, redundancy, and representation of DeBeque phacelia in five analytical units (AUs) (Figure 1). Boundaries for these AUs incorporate all known suitable and occupied habitats and are delineated by natural geological features (e.g., soil type) and a generalization of management boundaries. The 5 AUs are delineated around 26 known element occurrence (EO) areas, as defined by the Colorado Natural Heritage Program (CNHP 2020, entire). EOs are occupied or previously occupied habitat that contributes or potentially contributes to the persistence of the species at a location (CNHP 2020, entire). Our SSA report (Service 2022, entire) includes 25 EOs; however, since completion of the SSA report, we received updated information from CNHP that included an additional EO. Therefore, we are using the current information indicating 26 EOs in this document, and future updates to the SSA report will incorporate this new information. The addition of this newest EO did not change the delineation of the 5 AUs described in the SSA.

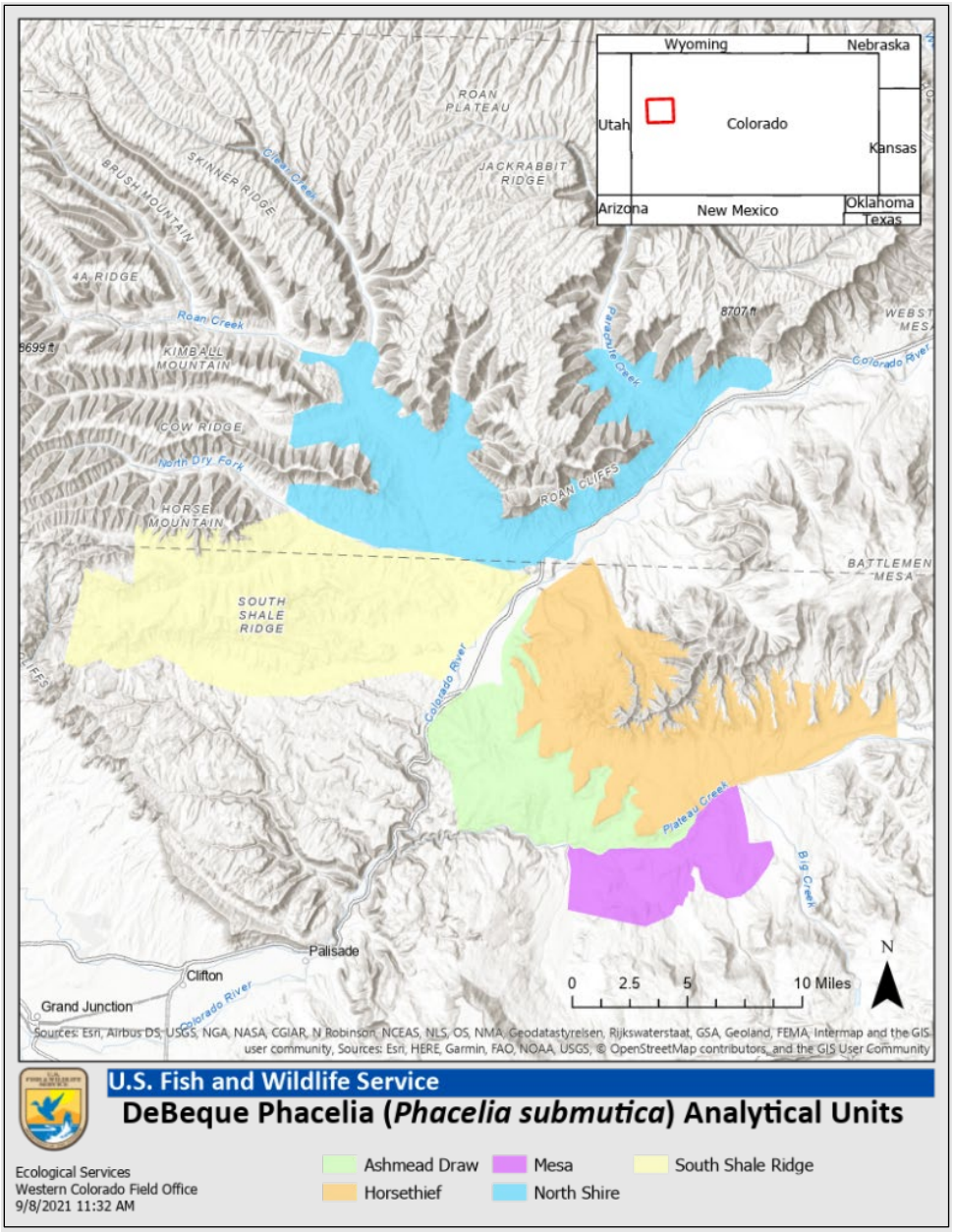

Figure 1. The five AU boundaries used to analyze DeBeque phacelia resiliency, redundancy, and representation. The five AUs are: yellow – South Shale Ridge; blue – North Shire; purple – Mesa; orange – Horsethief; green – Ashmead Draw. All AUs are located in the southern Piceance Basin near the town of DeBeque – reflected in the map insert, upper right corner, in Mesa and Garfield Counties of western Colorado.

This streamlined recovery plan is derived from the SSA report (Service 2022, entire) and focuses primarily on the elements required under section 4(f)(1)(B) of the Act:

(i) A description of such site-specific management actions as may be necessary to achieve the plan's goal for the conservation and survival of the species;

(ii) Objective, measurable criteria which, when met, would result in a determination, in accordance with the provisions of this section, that the species be removed from the list; and
(iii) Estimates of the time required and the cost to carry out those measures needed to achieve the plan's goal and to achieve intermediate steps toward that goal.

In cooperation with our partners, we have also prepared a recovery implementation strategy (RIS) for DeBeque phacelia, which serves as an operational plan for stepping down the higher-level recovery actions into specific tasks, or activities (Service 2024, entire). The RIS is a separate document from this Recovery Plan and can be modified as needed if monitoring reveals that expected results are not being achieved, thereby maximizing the flexibility of recovery implementation. The SSA can also be updated as needed to incorporate the latest scientific information. To summarize, there are three documents under the Service's recovery planning and implementation (RPI) framework: (1) the SSA report, which provides the foundational scientific information to guide recovery planning; (2) the recovery plan (this document) which provides the recovery vision, objective and measurable recovery criteria, site-specific management actions, and estimates of time and cost; and (3) the RIS, which is the operational plan with the detailed activities needed for recovery.

Overview of Species Life History and Status

The following is a brief overview of the natural history and status of DeBeque phacelia, as documented in our SSA report (Service 2022, entire). Please refer to the SSA report (Service 2022, entire) for additional discussion, full analysis, and complete literature citations.

DeBeque phacelia is a rare annual narrow endemic forb found on clay soils of the Wasatch Formation in Mesa and Garfield Counties, Colorado. It is found on slopes that average 14 degrees and elevation bands between 5,026 and 6,424 feet (1,532 and 1,958 meters). It has a short-lived annual growing season, April through June, with seeds germinating in March (Langton 2015, p. 66). DeBeque phacelia seeds do not have the required mechanisms to facilitate horizontal dispersal; therefore, seeds scatter directly beneath the mother plant, known as gravity dispersal, between July and September (Langton 2015, entire). Upon drying, cracks form in the shrink-swell soils this plant prefers, which allow a space for seeds that fall, and upon wet conditions, the cracks close and provide a seed bank. Seeds contained in these seed banks can remain dormant for at least 6 years (Langton 2015, p. 77). DeBeque phacelia requires specific environmental conditions to break seed dormancy; it is currently unknown exactly what those conditions are, but they likely involve a mix of temperature and precipitation. Additionally, DeBeque phacelia uses only self-fertilization for reproduction (Langton 2015, p. 11), which limits its genetic diversity (Anderson and McGlaughlin 2020, p. 47).

Currently, stressors that could influence DeBeque phacelia include livestock use, invasive species, energy production, off-highway vehicle (OHV) recreational use, and the effects of global climate change (Service 2022, pp. 20–23). Utility and communication line improvements were referenced in the listing rule as one of the many factors that could influence species status; these activities could affect the plant by facilitating human access to sensitive habitats. However,

utility and communication lines and their associated rights-of-way do not currently present a direct species-level concern (Service 2022, p. 21).

Though we identified habitat fragmentation as a threat at the time of listing, due to our new understanding of the plant's reproductive strategy (i.e., self-fertilization), habitat fragmentation is less of a concern. This plant can continue to reproduce without connectivity between sites. However, uncertainty remains as to the role of pollinators and whether the plant can also reproduce sexually, which would necessitate connectivity. In addition, the naturally limited range of the species' suitable habitat makes the species more vulnerable to these stressors.

We evaluated the needs of DeBeque phacelia in terms of resiliency, redundancy, and representation. The species' resource needs must be of the quantity and quality necessary to support individuals within each AU. Specifically, DeBeque phacelia individuals prefer areas with less than 20 percent vegetative canopy cover; specific soil types with highly developed soil structure; and adequate spring precipitation to stimulate germination, sustain the plant through reproduction, and replenish seed bank conditions. Resilient DeBeque phacelia populations need a sufficient number of individuals with adequate levels of reproduction and recruitment to bounce back after experiencing environmental stochasticity.

Currently, all five AUs have moderate resiliency. This is due to favorable levels of vegetative cover in most EOs, moderate conditions for soil functional integrity (see Service 2022, p. 28), and relatively low conditions for number of individual plants. Redundancy for narrow endemic species is inherently limited; however, DeBeque phacelia plants are distributed across the range of the species in the five defined AUs, providing redundancy throughout its relatively small geographic range. Genetic studies suggest that self-fertilization in this species may reduce genetic variation, limiting representation for DeBeque phacelia (Anderson and McGlaughlin 2020, entire). Our SSA report provides additional detail regarding the species' current conditions (Service 2022, pp. 13 – 33).

We projected the resiliency of DeBeque phacelia populations and the redundancy and representation of the species through mid-century. We selected mid-century (around 2050) because this timeframe is short enough for us to reasonably project changes in climate conditions and species stressors, yet long enough to be biologically meaningful to the species and to begin to understand the response of ecosystems to those changes. Given the level of uncertainty about the conditions that may be present in 2050, these scenarios represent optimistic, continuation, and pessimistic future conditions to capture the plausible range of future conditions the species may experience. Therefore, our evaluation of future conditions presents a plausible range of expected species responses.

Additionally, we developed climate scenarios to incorporate into our future scenarios. We used available historical data and modeled future climate data obtained from the North Central Climate Adaptation Science Center (NCCASC), the Cooperative Institute for Research in Environmental Sciences, and the Climate Toolbox (Hegewisch and Abatzoglou 2020, entire; NCCASC 2021, p. 1) to develop future climate scenarios. Using data from 1979–2000 and 2011–2020, we obtained a baseline of historical and current climate conditions, respectively, across the range of DeBeque phacelia in western Colorado. Specifically, we obtained the

historical mean spring water deficit values (4.8 inches [12.2 centimeters]) and current mean spring water deficit values (6.0 inches [15.2 centimeters]). We then selected three future climate models that represent the range of projected future climate conditions in the area: warm and wet; moderately hot; and hot and dry (Table 1).

Table 1. Projected future (2040–2069) mean spring water deficit values in inches (centimeters) for three climate scenarios for the range of DeBeque phacelia in western Colorado. Spring is considered February, March, and April.

Warm and Wet Climate Scenario	Moderately Hot Climate Scenario	Hot and Dry Climate Scenario
5.4 (13.7)	6.6 (16.8)	6.8 (17.3)

Table 2 describes the three future scenarios used to evaluate the plausible range of conditions DeBeque phacelia may experience by mid-century. By capturing the wide range of plausible future scenarios, we can assume that actual future conditions will likely fall somewhere between these projected scenarios. Beyond mid-century, there is too much uncertainty regarding the content of Resource Management Plans and other future management strategies to accurately project the species' future conditions.

Table 2. Three future scenarios that represent the range of plausible future environmental conditions DeBeque phacelia may experience, in relation to the species' stressors. See Table 1 for projected future climate conditions.

Source/Stressor/ Conservation Effort	***Future Scenario 1: Optimistic***	***Scenario 2: Continuation***	***Scenario 3: Pessimistic***
Conservation Effort: Occupied habitat managed for DeBeque phacelia or other rare plant conservation	More fencing for protection and/or road closures; increase in Bureau of Land Management (BLM) Areas of Critical Environmental Concern (ACEC)	The areas that are currently fenced remain fenced; BLM ACEC areas and Colorado Natural Areas Program (CNAP) protected areas remain on the landscape.	No new fencing nor maintenance of current fencing; no new ACEC or CNAP areas are added
Stressor: Livestock Use	Livestock movement decreases in occupied or suitable habitats or occurs at levels below disturbance thresholds	Livestock movement continues in some areas of occupied and suitable habitat; livestock movement continues at current levels in all AUs with the potential to degrade habitat and cause damage to plants and seed bank	Livestock movement occurs on a large percentage of occupied and suitable habitats, causing damage to plants and seed banks

Source/Stressor/ Conservation Effort	***Future Scenario 1: Optimistic***	***Scenario 2: Continuation***	***Scenario 3: Pessimistic***
Stressor: Recreational use, including off-highway vehicle (OHV) use (driving off designated routes) and increased human activity	Less OHV use off designated trails; OHV user adherence to road and trail closures	Continuation of current closures and OHV user adherence to these closures; no potential for discovery of new areas by OHV users	Travel Management Plan revised to add new OHV trails, creating more opportunity for travel outside designated areas and into DeBeque phacelia habitat
Stressor: Invasive plant species that increase the vegetative cover	Invasive plant species occur in some areas of occupied and suitable habitat; landowners and agencies implement invasive species prevention and management measures when soil disturbing activities occur	Invasive plant species occur in some areas of occupied and suitable habitat; landowners and agencies implement invasive species prevention and management measures when soil disturbing activities occur	Prevention and management of invasive plant species decline in effectiveness; as a result, invasive plants cause negative effects to DeBeque phacelia populations
Stressor: Land development, including: • Energy Production (e.g., test wells, well drilling, pipelines) • Communication/ Utility Lines (e.g., digging, paving access roads, driving off-road, increased human activity)	Little new development; currently developed areas have present or future plans for restoration to provide additional habitat; non-renewal of expired leases	No additional development; currently developed areas remain developed; review of older leases that may be closed to exploration to provide for better protection of the species	Additional development converts currently occupied and suitable habitats to unsuitable habitats.
Stressor: Effects of global climate change	Warm and Wet Climate Scenario	Moderately Hot Climate Scenario	Hot and Dry Climate Scenario

Under Scenario 1, an increase in conservation efforts and spring precipitation will maintain or improve habitat conditions for DeBeque phacelia, improving resiliency in all 5 AUs from moderate to high condition. Under Scenario 2, conservation efforts for DeBeque phacelia continue as they are currently, maintaining habitat similar to current conditions. However, spring water deficit increases, meaning less water is readily available for the species. As a result, some populations of DeBeque phacelia are projected to experience declines in resiliency; however, overall resiliency for each of the 5 AUs is maintained in moderate condition. Finally, under

Scenario 3, conservation efforts for DeBeque phacelia are substantially reduced, reducing habitat conditions for the species. Additionally, spring water deficit is projected to result in considerably drier conditions, and all 5 AUs are projected to experience reductions in resiliency from moderate to low condition. Current levels of resiliency for DeBeque phacelia in each AU and the resiliency under each of the three future scenarios are presented in Table 3.

Table 3. Summary of current and future resiliency of DeBeque phacelia for each AU under current conditions and under three future scenarios.

CURRENT AND FUTURE RESILIENCY				
AU Name	***Current Condition***	***Future Optimistic Scenario***	***Future Continuation Current Scenario***	***Future Pessimistic Scenario***
South Shale Ridge	Moderate	High	Moderate	Low
North Shire	Moderate	High	Moderate	Low
Ashmead Draw	Moderate	High	Moderate	Low
Horsethief Mountain	Moderate	High	Moderate	Low
Mesa	Moderate	High	Moderate	Low

RECOVERY PLAN FOR DEBEQUE PHACELIA

Recovery Vision

The recovery vision is the conservation and survival of DeBeque phacelia. Recovery for DeBeque phacelia will be signified by at least five analytical units (AUs) with moderate to high resiliency across the species' range. EOs with suitable canopy cover and soil functional integrity will be maintained across these five AUs. Additional areas of suitable canopy cover and soil functional integrity will be identified within potentially suitable habitat across the species' range. This condition would preserve the current genetic and ecological diversity across suitable habitats within the species' range.

Recovery Strategy

The recovery strategy describes the path needed to achieve the recovery vision. The recovery strategy for DeBeque phacelia is to implement the recovery actions and activities to maintain or improve the resiliency of DeBeque phacelia populations. The Service measures species viability in terms of resiliency, redundancy, and representation, as described in the SSA report (Service 2022, entire). Through the recovery vision, recovery criteria, and recovery actions outlined in this recovery plan, we attempt to conserve representation and maintain or improve the resiliency and redundancy of DeBeque phacelia. Given these considerations, the best available scientific information, as summarized in our SSA report (Service 2022, entire), and the input of species experts, this recovery plan recommends the conservation of all five currently extant AUs of DeBeque phacelia to preserve the genetic and ecological representation of the species across its range. To achieve the recovery vision, the recovery strategy for DeBeque phacelia is to:

- Maintain or improve resiliency of the five AUs;
- Reduce or remove threats to the species by maintaining or improving habitat protections;
- Maintain habitat within the five AUs;
- Survey appropriate areas for new populations and potential or occupied habitat; and
- Monitor the progress of recovery.

The conservation and recovery of DeBeque phacelia will require human intervention and participation. To fully recover the species, we intend to collaborate, build, and strengthen existing partnerships to facilitate recovery. Leveraging partnerships with all stakeholders, including state and Federal agencies, non-governmental organizations, private landowners, universities, and industry professionals will help to reduce threats and address knowledge gaps that will inform recovery.

DeBeque phacelia's five AUs currently have moderate resiliency (Service 2022, p. 32), and achieving recovery will require maintaining or improving upon the current levels of resiliency. Across its limited range, DeBeque phacelia is relatively abundant, with individuals occurring in 26 separate EOs across 5 AUs. Redundancy for narrow endemic species is inherently limited; however, DeBeque phacelia plants are distributed across the range of the species within the five moderately resilient AUs, providing redundancy throughout its relatively small geographic range.

Population size and distribution are critical considerations for conservation prioritization to maintain resiliency and representation. Small, fragmented populations with limited gene flow are susceptible to inbreeding and face a greater risk of extinction (Frankham 2003). Populations with few individuals and low effective population size are likely to suffer from low genetic diversity (Loveless and Hamrick 1984; Ellstrand 1992; Ellstrand and Elam 1993). As population size diminishes, the chance that genetic diversity is lost increases, and the likelihood that gene flow from distant populations will replenish genetic variability decreases (Loveless and Hamrick 1984). Species with depleted populations are more susceptible to both predictable and unexpected genetic, environmental, and demographic variables (Soule 1987; Simberloff 1988; Ellstrand 1992; Ellstrand and Elam 1993).

Maintaining representative populations from across the range of DeBeque phacelia and ecological variation within and between populations are key elements of the recovery strategy. The preservation of genetic diversity across populations is important not only for short-term persistence but also provides future adaptation and evolutionary potential (i.e., representation), thereby increasing the species' probability of persistence over the long term (Newman and Pilson 1997; Neel and Cummings 2003). However, recent genetic studies found that the self-fertilization strategy of DeBeque phacelia limits its genetic diversity (Anderson and McGlaughlin 2020, p. 2) making this rare plant vulnerable to novel stressors (Anderson and McGlaughlin 2020, p. 47). This lack of genetic variability within and between populations may compromise the species' ability to adapt to changing environmental conditions, which limits representation for the species. Therefore, maintaining the limited genetic diversity currently existing within this species is important to the recovery of this species.

The effects of climate change are the largest area of uncertainty for many narrow endemic plant species. Climate change could reduce the availability of the specific moisture and temperature regimes required by DeBeque phacelia. Based on the variation and uncertainties in projected future climate conditions, climate change could also make conditions more favorable for the species, though western Colorado is already experiencing higher temperatures, more frequent and prolonged drought, earlier snowmelt, larger and more intense fires, more extreme storms, and the spread of invasive species (Rondeau et al., 2017, p. 1). The self-fertilization strategy of DeBeque phacelia could exacerbate the impacts of a changing climate because it may limit the species' ability to adapt to changing temperature and precipitation regimes (Lande et al. 1999).

The recovery strategy for DeBeque phacelia will focus on conserving the five known AUs, primarily by maintaining and expanding habitat protections within them. This will maintain or improve the resiliency of populations. We anticipate 15 years of monitoring information to be sufficient to measure demographic criteria for each AU. We also seek to conduct research to address biological uncertainties, develop monitoring and survey methods, and survey for additional populations of DeBeque phacelia. This recovery strategy will require that we:

- Effectively manage DeBeque phacelia and its habitat, taking into account environmental changes and new information;
- Monitor population trends, emerging stressors and threats to the species, and the effectiveness of conservation measures;
- Ensure that *ex-situ* (off-site) measures are in place to minimize extinction risk and loss of genetic diversity from population declines or catastrophic events;

- Engage partners in the continued commitment to the conservation and recovery of the species through coordination and collaboration.

II. 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 protections afforded by the Act are no longer necessary and a species 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 an endangered species to a threatened species. The term "endangered species" means any species (species, subspecies, or Distinct Population Segment) that is in danger of extinction throughout all or a significant portion of its range. The term "threatened species" means any species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

Revisions to the Lists, including delisting or downlisting a species, must reflect determinations made in accordance with sections 4(a)(1) and 4(b) of the Act. Section 4(a)(1) requires that the Secretary determine whether a species is an endangered species or threatened species (or not) because of threats to the species. Section 4(b) of the Act requires that the determination be made "solely based on the best scientific and commercial data available." Thus, while recovery plans provide important guidance on methods of minimizing threats to listed species and measurable objectives against which to measure progress toward recovery, they are guidance and not regulatory documents. Recovery criteria help indicate when we would anticipate that an analysis of a species' status under section 4(a)(1) would result in a determination that the species is no longer an endangered species or a threatened species. A decision to revise the status of, or remove a species from the Lists, however, is ultimately based on an analysis of the best scientific and commercial data then available, regardless of whether that information differs from the recovery plan. When changing the status of a species, we first propose the action in the *Federal Register* to seek public comment, followed by a final decision announced in the *Federal Register*. The following recovery criteria are based on information compiled in the SSA report (Service 2022, entire), and other input provided by DeBeque phacelia experts as well as conservation partners from across the range of the species.

Delisting Criteria

The following recovery criteria for delisting, when met collectively, would indicate that DeBeque phacelia may no longer need the protections of the Act.

Recovery Criterion 1:
Presence of DeBeque phacelia is maintained within at least 20 EOs across 5 analytical units (AUs).

Justification for Criterion 1: Currently, DeBeque phacelia has been documented within 26 EOs across 5 AUs, 20 of which have had observations of DeBeque phacelia within the last 20 years. Six EOs are historical (i.e., have not had an observation within the last 20 years), and are

difficult to access (i.e., occur on private lands), have not been revisited, or plants were not located during revisits to the EO. All 20 currently extant EOs are needed to support genetic diversity of DeBeque phacelia. Currently, there is no standardized or accepted methodology to monitor populations of DeBeque phacelia because walking on the fragile substrate in which it grows can damage individuals and possibly seeds within the seed bank. Determination of species presence (e.g., presence of aboveground plants or a persistent seed bank) will require development of monitoring methods and standardized survey protocols (Recovery Actions 1 and 2, below). This criterion is objective because it recommends a needed demographic threshold to maintain species genetic diversity across the range of DeBeque phacelia. Implementing Recovery Actions 1 and 2, as described below, will ensure that this criterion is measurable.

***Recovery Criterion 2*:**
In at least 13 EOs, the number of aboveground plants remains at or above 500 individuals during years where aboveground growth is observed at known occurrences of DeBeque phacelia over a 15-year period.

Justification for Criterion 2: Currently, 13 EOs have at least 500 aboveground plants, which corresponds to moderate resiliency for that demographic metric (Service 2022, p. 32). We believe that for the populations to demonstrate sufficient resiliency such that they contribute to the viability of the species, at least 13 populations need at least 500 individuals. Populations in this moderate resiliency category, with at least 500 individuals, would be better able to withstand environmental and stochastic disturbances, such as droughts or years of low productivity. This criterion is objective because it recommends an additional, quantitative demographic threshold—abundance—for the populations identified under Criterion 1. Like Criterion 1, Recovery Actions 1 and 2 are needed to develop and standardize demographic monitoring methods for DeBeque phacelia to measure this criterion.

***Recovery Criterion 3*:**
Maintain habitat quality, as measured by low (less than 20 percent) vegetative cover and high soil functional integrity, within known occupied habitat for DeBeque phacelia across all 5 analytical units (AUs) over a 15-year period.

Justification for Criterion 3: This criterion recognizes the importance of threat reduction and amelioration to maintain habitat quality for DeBeque phacelia. This species occurs on barren clay soils and grows only in areas where other vegetation is sparse (Service 2022, p. 15). The plant prefers areas with less than 20 percent cover of other plants (77 FR 48381). Other pioneer plants, including invasive plant species, may also occur in these areas, outcompeting DeBeque phacelia for available sunlight, nutrients, and moisture (Service 2022, p. 21). Additionally, DeBeque phacelia requires well-developed soils with very specific soil properties. High soil functional integrity is necessary for plant establishment, growth, and reproduction (Service 2022, p. 14). Maintenance of low vegetative cover and high soil functional integrity within known occupied habitat for DeBeque phacelia would correspond to high condition for these habitat factors based on our calibrated scale of resiliency for DeBeque phacelia (Service 2022, p. 26). This criterion is objective because it identifies quantitative thresholds for habitat quality that correspond to resilient populations of DeBeque phacelia. Recovery Actions 1 and 2 are needed to develop habitat assessment approaches to measure this criterion.

***Recovery Criterion 4*:**
Maintain or improve existing regulatory mechanisms and associated protective measures for the 9 EOs within currently designated ACECs. For EOs on Federal lands outside of these ACECs, new or amended land management designations may include adequate protective measures for DeBeque phacelia and its habitat to reduce or ameliorate threats associated with soil disturbance and non-native, invasive plant species. On lands outside of Federal management, additional protective measures may include formal land management designations, management agreements, conservation agreements, easements, or other conservation plans or mechanisms.

Justification for Criterion 4: Regulatory mechanisms or conservation plans are necessary to reduce or ameliorate threats to the species, and to ensure that habitats are of sufficient quality and quantity to support resilient populations and the continued, long-term viability of DeBeque phacelia. Currently, 63 percent of occupied habitat occurs within ACECs. Additional land management designations on Federal lands outside of these ACECs will provide additional protections. Coordination with state agencies and other stakeholders will be needed to implement additional protective measures for occurrences of DeBeque phacelia on lands outside of Federal management. This criterion is objective because it recommends establishing conservation mechanisms that reduce threats to the five AUs needed for recovery. Achieving this threat-reduction criterion will ensure that Criteria 1, 2, and 3 may also be successfully achieved. This criterion will be measured by the maintenance or improvement of existing regulatory mechanisms or establishment of new regulatory mechanisms or other conservation plans, as described under this criterion.

Recovery Criterion 5:
All AUs are represented in an ex-situ seed collection that is managed according to the Center for Plant Conservation guidelines (Guerrant et al. 2004, entire). The ex-situ seed collection should contain existing levels of genetic diversity (representation) of DeBeque phacelia across the species' range.

Justification for Criterion 5:
Ex-situ seed storage will preserve the genetic diversity (representation) of DeBeque phacelia and provide added protection from stochastic and catastrophic events. This criterion will be measured by the development and completion of these seed collections, as described under the criterion.

III. PRIORITIZED RECOVERY ACTIONS

The following is a list of prioritized actions, including site-specific management actions, that when fully implemented are expected to result in the recovery of DeBeque phacelia. Priority 1 actions are defined as those actions that currently available information suggests, must be taken to prevent extinction or to prevent the species from declining irreversibly in the foreseeable future. Priority 2 actions are those that must be taken to prevent a significant decline in population size or habitat quality or some other significant negative impact. Priority 3 actions are all other actions necessary to provide for the full recovery of the species.

The assignment of priorities does not imply that some recovery actions are of low importance but instead implies that lower-priority items may be deferred while higher-priority items are being implemented. Please refer to Table 4 for a clear association between recovery actions and the threats addressed by these actions. The RIS contains the specific tasks required to implement these recovery actions (Service 2024, entire).

Priority 1 Actions:

1. Conduct primary research to fill information gaps on DeBeque phacelia ecology and inform development of monitoring methods (Criteria 1, 2, 3, and 4).
2. Develop standardized methodology for data collection and analysis to monitor all DeBeque phacelia EOs across all 5 AUs (Criteria 1, 2, 3, and 4).
3. Maintain or augment all extant DeBeque phacelia populations (EOs) on Federal and State lands in all five AUs (Criteria 1, 2, 3, and 4).
4. Develop *ex-situ* (off-site) collections of seeds to preserve DeBeque phacelia genetic diversity (representation) and provide the capability to augment existing populations, if necessary (Criterion 5).

Priority 2 Actions:

5. Survey for additional populations of DeBeque phacelia (Criteria 1 and 2).

Priority 3 Actions:

6. If there is a population decline or loss (e.g., based on the results of Recovery Actions 1 and 2), develop and implement a range-wide strategy for population augmentation, or if necessary, re-introductions (Criteria 1, 2, and 3).

Table 4. Factors affecting the survival of DeBeque phacelia, associated recovery criteria, and associated recovery actions.

Listing Factors under the Act	Threats Description	Recovery Criteria	Recovery Actions
Factor A The present or threatened destruction, modification, or curtailment of its habitat or range	Livestock use; invasive and introduced species; recreation; energy production; communication and utility lines	1, 2, 3, 4	1, 2, 3, 5, 6
Factor D The inadequacy of existing regulatory mechanisms	Regulatory mechanisms and conservation measures are lacking outside of existing designated management areas	4	3, 6
Factor E Other natural or manmade factors affecting its continued existence	Climate change; reproductive strategy	1, 2, 3, 4, 5	1, 2, 3, 4, 5, 6

IV. ESTIMATED TIME AND COSTS TO ACHIEVE RECOVERY

We summarized the estimated time and costs to achieve the recovery of DeBeque phacelia (Table 5). The values in this table are derived from estimates of time and costs of actions similar to those described as recovery actions, above, and do not account for possible future inflation. These estimates are described more specifically in the actions and activities developed collaboratively with Federal, state, non-governmental organizations (NGOs), and local stakeholders in the Recovery Implementation Strategy (RIS). Cost estimates include financial as well as volunteer and in-kind support. Table 5 shows only the actions to be implemented specifically for the recovery of DeBeque phacelia. We estimate that the full implementation of these actions would improve the status of DeBeque phacelia so that it could be delisted within 15 years following the adoption of this plan. We note that the recovery program may change over time, and the timeframe estimated to implement the recovery action to achieve recovery of the species may take longer than expected.

Table 5. Estimated cost per year to implement each recovery action. The total cost to implement all recovery actions is $1,780,500 in a 15-year time frame. Estimates are in thousands of dollars.

Time Frame (Years)	Cost for Recovery Action 1	Cost for Recovery Action 2	Cost for Recovery Action 3	Cost for Recovery Action 4	Cost for Recovery Action 5	Cost for Recovery Action 6	Total Cost by Year ($1,000s)
Year 1	29.0	29.0	29.0	1.5	20.5	20.5	129.5
Year 2	23.0	23.0	23.0	1.5	20.5	20.5	111.5
Year 3	24.0	24.0	24.0	1.5	20.5	20.5	114.5
Year 4	24.5	24.5	24.5	1.5	20.5	20.5	116
Year 5	25.0	25.0	25.0	1.5	20.5	20.5	117.5
Years 6-10	126.0	126.0	126.0	7.5	102.5	102.5	590.5
Years 11-15	129.5	129.5	129.5	7.5	102.5	102.5	601
Total Cost by Recovery Action	**381**	**381**	**381**	**22.5**	**307.5**	**307.5**	**1,780.5**

V. LITERATURE CITED

Anderson, B., and M. McGlaughlin. 2020. Genetic studies of *Phacelia submutica* (DeBeque phacelia). Funded by Bureau of Land Management, Colorado.

Colorado Natural Heritage Program (CNHP). 2020. Element Occurrence Reports for *Phacelia submutica*. Colorado State University, Fort Collins, Colorado. 54 pp.

Ellstrand, N.C. 1992. Gene flow by pollen: implications for plant conservation genetics. Oikos 63(1):77–86.

Ellstrand, N.C., and D.R. Elam. 1993. Population genetic consequences of small population size: implications for plant conservation. Annual Review of Ecology and Systematics 24(1):217–242.

Frankham, R. 2003. Genetics and conservation biology. Comptes Rendus Biologies 326:22–29.

Guerrant, E., P. Fiedler, K. Havens, and M. Maunder. 2004. Revised genetic sampling guidelines for conservation collections of rare and endangered plants: supporting species survival in the wild. *In* Ex situ plant conservation: supporting species survival in the wild. Island Press.

Hegewisch, K.C., and J.T. Abatzoglou. 2020. 'Data Download' web tool. Climate Toolbox (https://climatetoolbox.org/), version 2020-04-17.

Lande R., L. Landweber, and A. Dobson. 1999. Extinction risks from anthropogenic, ecological, and genetic factors. In: Landweber L. F. & Dobson A. P. (eds). *Genetics and the Extinction of Species: DNA and the Conservation of Biodiversity*. Princeton University Press, Princeton, pp. 1–22.

Langton, A. 2015. Factors contributing to the conservation of *Phacelia submutica* (Boraginaceae), a threatened species in Western Colorado: reproductive biology and seed ecology. Utah State University Graduate Theses and Dissertations. 4284. https://digitalcommons.usu.edu/etd/4284. https://doi.org/10.26076/47b0-f218.

Loveless, M.D., and J.L. Hamrick. 1984. Ecological determinants of genetic structure in plant populations. Annual Review of Ecology and Systematics 15(1):65–95.

Neel, M.C., and M.P. Cummings. 2003. Effectiveness of conservation targets in capturing genetic diversity. Conservation Biology 17(1):219–229.

Newman, D., and D. Pilson. 1997. Increased probability of extinction due to decreased genetic effective population size: experimental populations of Clarkia pulchella. Evolution 51(2):354–362.

North Central Climate Adaptation Science Center (NCCASC). 2021. Climate scenarios by 2050 for DeBeque phacelia and Colorado hookless cactus. University of Colorado, Boulder.

Rondeau, R., M. Bidwell, B. Neely, I. Rangwala, L. Yung, K. Clifford, and T. Schulz. 2017. Sagebrush Landscape: Upper Gunnison River Basin, Colorado: Social-Ecological Climate Resilience Project. North Central Climate Science Center, Fort Collins, Colorado.

Simberloff, D. 1988. The contribution of population and community biology to conservation science. Annual Review of Ecology and Systematics 19(1):473–511.

Soule, M.E. 1987. Viable populations for conservation. Cambridge university press.

U.S. Fish and Wildlife Service (Service). 2013. Recovery Outline DeBeque Phacelia (*Phacelia submutica*).

U.S. Fish and Wildlife Service (Service). 2022. Species Status Assessment for DeBeque phacelia (*Phacelia submutica*). Lakewood, Colorado.

U.S. Fish and Wildlife Service (Service). 2024. Recovery implementation strategy (RIS) for DeBeque phacelia (*Phacelia submutica*). August 2024. U.S. Fish and Wildlife Service, Mountain-Prairie Region, Denver, Colorado. 7 pages.

VI. APPENDIX A – SUMMARY OF PUBLIC COMMENTS

We announced a notice of availability of a draft recovery plan for DeBeque phacelia (*Phacelia submutica*) on December 13, 2023. With that notice, we requested public review and solicited comments from the scientific community, state and federal agencies, Tribal governments, and other interested parties on the general information, assumptions, and conclusions presented in the draft recovery plan. We also posted an electronic version of the draft recovery plan and recovery implementation strategy on our website: *https://ecos.fws.gov/ecp/species/4639*.

During the public comment period, we received only minor editorial suggestions or recommendations for clarification and no substantive comments on the draft recovery plan for DeBeque phacelia. Additionally, one commenter suggested that we include recovery action number 4 as a Priority 1 action instead of a Priority 2 action. We agree with this suggestion, and list recovery action 4 as a Priority 1 action, as adequate seed collection will be needed to implement several other Priority 1 actions.

No substantial new information or changes in the understanding of this species' recovery have arisen since the draft recovery plan public comment period, although we did update minor phrasing to ensure consistency between the final recovery plan and the recovery implementation strategy. Therefore, this final recovery plan incorporates all relevant information pertaining to the recovery of DeBeque phacelia.