

Recovery Plan for Slickspot Peppergrass (*Lepidium papilliferum*)

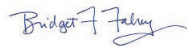


Photograph by Greg Burak, U.S. Fish and Wildlife Service.

**Recovery Plan
for
Slickspot Peppergrass
(*Lepidium papilliferum*)**

U.S. Fish and Wildlife Service
Portland, Oregon

Approved:



Digitally signed by BRIDGET
FAHEY
Date: 2026.05.06 15:10:17 -07'00'

Acting Regional Director, Pacific Region 1

PURPOSE AND DISCLAIMER

This document presents the U.S. Fish and Wildlife Service's (Service) plan for the conservation of slickspot peppergrass (*Lepidium papilliferum*). The recovery plan is the second part of the Service's three-part recovery planning framework and includes the statutorily required elements pursuant to section 4(f) of the Endangered Species Act of 1973, as amended (Act). This recovery plan is informed by the first part of the framework, a Species Status Assessment (SSA). The SSA report delivers foundational science for informing decisions related to the Act and includes an analysis of the best available scientific and commercial information regarding a species' life history, biology, and current and future conditions that characterize the species' viability (i.e., ability to sustain populations in the wild over time) and extinction risk. We have also prepared a Recovery Implementation Strategy (RIS), the third part of the framework. The RIS is an easily updateable operational plan that is separate and complimentary to the recovery plan that details the on-the-ground recovery activities needed to complete the recovery actions contained in the recovery plan.

Recovery plans describe the envisioned recovered state for a listed species (when it should no longer meet the Act's definitions of a threatened species or endangered species) and include a recovery strategy, recovery criteria, recovery actions, and the estimates of time and cost needed to achieve it. Plans are published by the Service and are often prepared with the assistance of recovery teams, contractors, State agencies, and others. Recovery plans do not necessarily represent the views, official positions, or approval of any individuals or agencies involved in plan formulation, other than the Service. They represent the official position of the Service only after they have been signed by the Regional Director as approved. Recovery plans are guiding and planning documents only; identification of an action to be implemented by any public or private party does not create a legal obligation beyond existing legal requirements. Nothing in this plan should be construed as a commitment or requirement that any Federal agency obligate or pay funds in any one fiscal year in excess of appropriations made by Congress for that fiscal year in contravention of the Anti-Deficiency Act, 31 U.S.C. 1341, or any other law or regulation. Approved recovery plans are subject to modification as dictated by new findings, changes in species status, and completion of recovery actions.

ACKNOWLEDGMENTS

This recovery plan has benefitted from the advice and assistance of many individuals, agencies, and organizations. We thank the following individuals for their assistance and apologize to anyone whose name was omitted inadvertently from this list: Private individuals and staff of the following organizations provided input to the plan, including Boise State University, Idaho Army National Guard, Idaho Department of Fish and Game, Idaho Department of Lands, Idaho Governor's Office of Species Conservation, Idaho Power Company, Idaho Transportation

Slickspot Peppergrass Recovery Plan

Department, Rangeland Fire Protection Associations, U.S. Air Force Mountain Home Air Force Base, U.S. Army Corps of Engineers, U.S. Bureau of Land Management, U.S. Forest Service, U.S. Geological Survey, U.S. Natural Resources Conservation Service, University of Idaho, and the Slickspot Peppergrass Technical Team.

Lead Authors

The lead authors were staff of the Idaho Fish and Wildlife Office of the Service.

RECOMMENDED CITATION AND ELECTRONIC AVAILABILITY

U.S. Fish and Wildlife Service. 2026. Recovery plan for slickspot peppergrass (*Lepidium papilliferum*). U.S. Fish and Wildlife Service, Region 1, Portland, Oregon, USA. iii + 32 pages.

An electronic copy of this Final Recovery Plan will be made available at:

<https://ecos.fws.gov/ecp/species/4027>

TABLE OF CONTENTS

I.	INTRODUCTION	1
	A. Species Life History.....	2
	B. Distribution and Population Status.....	3
	C. Threats.....	6
II.	RECOVERY	8
	A. Recovery Strategy	8
	B. Recovery Criteria	10
III.	RECOVERY ACTIONS.....	13
IV.	TIME AND COST ESTIMATES.....	19
V.	LITERATURE CITED	24
	APPENDIX A. Summary of Comments Received on Draft Recovery Plan.....	26

FIGURE

Figure 1. Geographic distribution of slickspot peppergrass in three areas: Foothills, Snake River Plain, and Jarbidge. Element Occurrences (EOs) indicate where the species is currently known to occur and where the species had previously occurred but was eliminated or where its status is uncertain..... 5

TABLES

Table 1: Crosswalk of listing factors to slickspot peppergrass recovery criteria and recovery actions. 15

Table 2: Recovery actions, priority, and estimated costs (in fiscal year 2025 dollars) for slickspot peppergrass. 20

I. INTRODUCTION

The Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq.*) (Act) protects species of wildlife and plants that are listed as endangered or threatened. Recovery is defined as “the process by which listed species and their ecosystems are restored and their future is safeguarded to the point that protections under the [Act] are no longer needed,” according to the National Marine Fisheries Service (NMFS) and U.S. Fish and Wildlife Service (Service, USFWS, or “we”) Interim Recovery Planning Guidelines, Version 1.4 (NMFS and USFWS 2018, p. 1.1-1).

Recovery plans are guidance documents developed to provide recommendations to reduce or alleviate threats to listed species (including distinct population segments, subspecies, and species) and ensure self-sustaining populations in the wild. Section 4(f)(1) of the Act stipulates that recovery plans include: (1) a description of site-specific management actions necessary to conserve the species; (2) objective, measurable criteria that, when met, will allow the species to be removed from the Federal Lists of Endangered and Threatened Wildlife and Plants (Lists); and (3) estimates of the time and cost required to achieve the plan’s goals and intermediate steps.

This recovery plan describes criteria for determining when slickspot peppergrass (*Lepidium papilliferum*) should be considered for delisting, lists site-specific actions that will be necessary to meet those criteria, and estimates the time and cost to achieve recovery. A summary of the species’ biology and status is provided, along with a discussion of factors limiting its populations. A detailed discussion of these and other topics pertinent to the recovery of slickspot peppergrass can be found in the Species Status Assessment of *Lepidium papilliferum*, Version 1.0 (USFWS 2020; SSA). Detailed activities implementing recovery actions will be developed in the Recovery Implementation Strategy (RIS). The RIS and SSA are finalized separately from the recovery plan and will be updated on a routine basis. These supplemental documents are available at: <https://ecos.fws.gov/ecp/species/4027>.

Slickspot peppergrass was listed as a threatened species under the Act on October 8, 2009 (USFWS 2009, entire). The final rule to list the species was vacated and remanded to the Service by the Idaho District Court on August 8, 2012, to reconsider the definition of “foreseeable future.” The Service reconsidered the definition of “foreseeable future” and the listing of the species as threatened was subsequently reinstated, effective September 16, 2016 (USFWS 2016, entire). The Service designated approximately 78,009 acres (31,569 hectares [ha]) of Federal land in five southwestern Idaho counties as critical habitat for the species on May 4, 2023 (USFWS 2023, entire). The physical or biological features of critical habitat for slickspot peppergrass are summarized as: ecologically functional microsites or “slick spots”; relatively intact native Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*) vegetation assemblages with low percentages or minimal competition with nonnative grasses; a diversity of

native plants whose blooming times overlap to meet pollinator needs; and sufficient insect pollinators for successful fruit and seed production.

A. Species Life History

Slickspot peppergrass is an annual, or sometimes biennial, member of the mustard family (Brassicaceae), occurring in the Great Basin sagebrush steppe of Ada, Gem, Elmore, Payette, and Owyhee Counties in southwestern Idaho. The species was historically reported in Canyon County, Idaho, but no extant occurrences are known to occur.

Above-ground plants represent only a portion of the population; the remainder occurs in the seed bank (a reserve of dormant seeds generally found in the soil), which in many years may constitute the majority of the population. Only a portion of the persistent seed bank germinates in any given year, which buffers slickspot peppergrass populations against years with unfavorable temperature and precipitation conditions that result in little or no reproduction. Seeds have been found to be viable for at least 12 years.

Slickspot peppergrass is primarily an outcrossing species, requiring pollen from separate plants for more successful fruit production. The species has low seed sets in the absence of insect pollinators. The primary seed dispersal mechanism is unknown, although the capsules and seeds do not appear to carry well in the wind. Because slickspot peppergrass appears to have limited capacity for seed dispersal and colonization of new habitat, maintenance of diverse and robust pollinator communities is likely important for the species' long-term survival. A broad, localized resource base that includes many types of flowering plants may help support insect pollinator communities, particularly in years when slickspot peppergrass plant numbers are low.

Slickspot peppergrass plants occur in soil locales known as slick spots. The species has been found to germinate in non-slick spot soil in disturbed areas near existing slickspot peppergrass populations, but observations to date indicate it does not persist at these sites. Slick spot microsites cover a small cumulative area within the larger sagebrush-steppe matrix and only some slick spots are currently known to be occupied by slickspot peppergrass. The soils of these slick spot microsites contrast with surrounding areas, which are primarily dominated by native sagebrush (*Artemisia* spp.) and its associated species. Slick spots contain distinct soil layers, and some slick spots form shallow puddles from rainfall or snow melt, which may inhibit competing plant species. Slick spot microsites in southwest Idaho appear to have formed many thousands of years ago during the Pleistocene geological epoch. Current climate conditions may not allow for the formation of new slick spots; therefore, any disturbance or loss of slick spot microsites within the range of slickspot peppergrass may be permanent.

Vegetation surrounding occupied slick spots influences the physical and biological features of slick spot microsites that are important for germination and growth of slickspot peppergrass plants. Shrubs, such as Wyoming big sagebrush and rabbitbrush (*Chrysothamnus* spp.) increase the availability of water in the soil through shading to reduce soil temperatures and associated evaporation, act as snow fences to retain snow important for spring moisture and make deep soil moisture and nutrients available closer to the drier soil surface through hydraulic lift. In addition, the presence of sagebrush cover has been found to limit Owyhee harvester ant (*Pogonomyrmex salinus*) occurrence, a native ant species that eats slickspot peppergrass seed (Robertson and Robertson 2020, pp. 986-990).

B. Distribution and Population Status

Slickspot peppergrass occurs patchily in southwestern Idaho and is distributed across three geographic areas based on landform, the Foothills geographic area, the Snake River Plain geographic area, and the Jarbidge geographic area (Figure 1). The Snake River Plain and the adjacent Foothills geographic area cover an area of approximately 90 by 25 miles (145 by 40 kilometers). The smaller disjunct Jarbidge geographic area is located about 45 miles (72 kilometers) to the south in the eastern Owyhee Uplands, where occurrences are within an area of approximately 11 by 12 miles (18 by 19 kilometers) (USFWS 2020, pp. 3–4).

Locations where slickspot peppergrass occurs, or has been known to occur, are described and mapped as Element Occurrences (EOs) (Colket et al. 2006, entire) for inventory and tracking purposes. EOs are identified for slickspot peppergrass by grouping together occupied slick spot microsites and the surrounding plant communities that occur within 0.6 miles (1 kilometer) of each other (USFWS 2020, p. 7). EOs may include several populations in proximity to one another and the number of slickspot peppergrass plants in an EO can vary greatly from a few to over 1,000.

The total range-wide extent of known EOs is approximately 16,269 acres (6,584 ha). Approximately 87 percent (14,182 acres, 5,739 ha) of the known EOs occurs on Federal lands (U.S. Bureau of Land Management (BLM), Idaho Army National Guard, U.S. Air Force, and Bureau of Reclamation). An additional 9 percent (1,502 acres, 608 ha) of known EO acres are located on State lands. The remaining 4 percent of known slickspot peppergrass EO acreage (about 594 acres, 240 ha) is privately owned (USFWS 2020, p. 8).

The term “EOs” is used in this recovery plan for consistency with the classification of slickspot peppergrass and designation of critical habitat under the Act (USFWS 2023, entire). The EO concept is based on the standards developed by NatureServe (NatureServe 2002, entire) and adopted by the Idaho Department of Fish and Game (IDFG). The condition of EOs in relation to their ability to support slickspot peppergrass has also been assessed (Kinter and Miller 2016,

entire) and ranked based on habitat quality within and around the EO and slickspot peppergrass abundance. The EO condition ranks include: A, AB, B, BC, C, CD, D, E, F, H, and X. EO rankings A-D provide rankings of habitat data and species abundance as follows: A (excellent), AB (good/excellent), B (good), BC (good/fair), C (fair), CD (fair/poor), D (poor). Rank E identifies areas with confirmed presence of slickspot peppergrass but limited habitat data; F describes previously identified EOs that surveyors failed to find in the most recent survey; H describes historical observations that have not been observed since 1970; and an X rank describes EOs that are extirpated (USFWS 2020, pp. 46–48). To date this has proven to be the most consistently applied method for evaluating slickspot peppergrass EOs and is recognized by all partners involved in monitoring.

Available information suggests that slickspot peppergrass abundance is declining across its range. The SSA assessed 11 years of annual monitoring data which indicated that slickspot peppergrass abundance declined since 2005 and was projected to continue to decline (USFWS 2020, pp. ii, 34–39). Kinter and Miller (2016, entire) assessed 115 currently known EOs and documented the rankings as: 0 A, 0 AB, 25 B, 4 BC, 40 C, 9 CD, 29 D, 2 F, and 6 require more field assessment to assign a rank. A more recent report (Miller and Kinter 2024, entire) re-assessed 60 of the 115 known EOs and based on current conditions, adjusted rankings are: 0 A, 0AB, 18 B, 3 BC, 47 C, 4 CD, 35 D, 2 E, 2 F, and 4 H. The recent report documented that 25 EO rankings changed since the 2016 report, with 19 declining to lower ranks and 6 improving to higher ranks. Since the recent report provides only a partial assessment of EOs across the range and available information is insufficient to update condition rankings for the 55 remaining EOs as of March 1, 2026, it is not possible to determine a trend between the two assessments.

As of March 1, 2026, research is ongoing regarding slickspot peppergrass taxonomic status and phylogenetic distribution. Slickspot peppergrass is considered one taxon (*Lepidium papilliferum*), but researchers have proposed—based on a comparison of 22 morphometric measurements of 61 herbarium specimens—that the slickspot peppergrass plants in the Jarbidge populations may warrant distinction as a new variety under *Lepidium montanum* (*Lepidium montanum* var. *owyheense*) (Mansfield and Barbour 2022, p. 14). At the time of that study, genetic information was inconclusive regarding whether or not to reassign the Jarbidge populations to a new variety of *Lepidium montanum* (Mansfield and Barbour 2022, p. 14).

When considering the species phylogenetic distribution, results from a new study based on a subset of locations throughout the range using nuclear rDNA and genetic clustering found genetic distinctiveness of individuals in the Jarbidge region. Genetic distinction between the Foothills and Snake River Plain was not supported by their analysis of available samples. The researchers suggest revising the concept of recognizing three geographic areas for management to instead recognize two distinct landscape management regions, separated by the Snake River. The first region, occurring south of the Snake River, aligns with the definition of the Jarbidge

region. The second region, occurring north of the Snake River, includes both the Foothills and Snake River Plain regions (Buerki et al. 2026, entire).

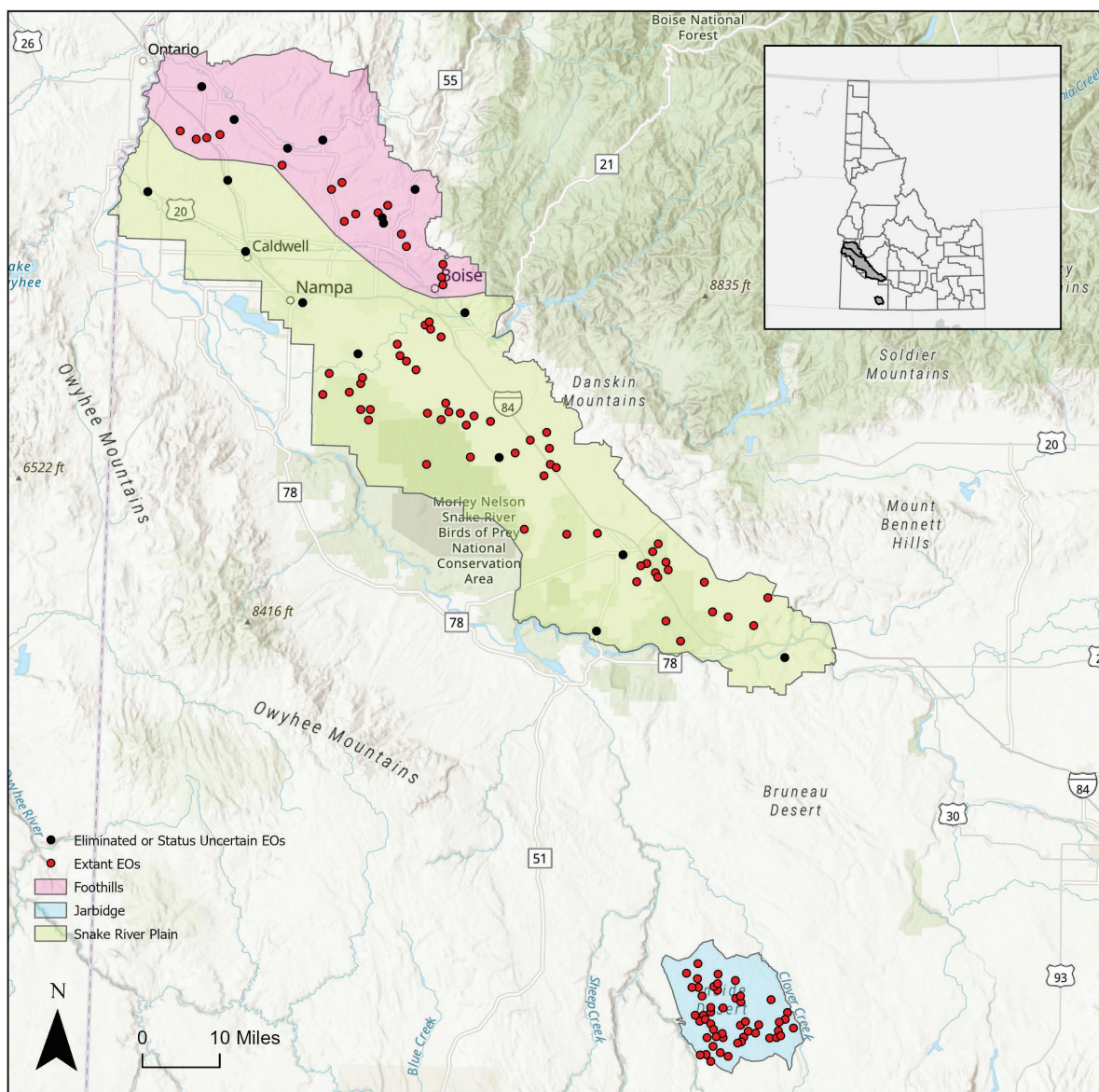


Figure 1. Geographic distribution of slickspot peppergrass in three areas: Foothills, Snake River Plain, and Jarbidge. Element Occurrences (EOs) indicate where the species is currently known to occur and where the species had previously occurred but was eliminated or where its status is uncertain.

C. Threats

The threats to slickspot peppergrass identified in the 2016 listing rule included destruction, modification, or curtailment of its habitat and range due to the increased frequency and extent of wildfires under a wildfire regime modified and exacerbated by the spread of invasive nonnative plants, particularly nonnative annual grasses such as *Bromus tectorum* (cheatgrass). Other threats to the species identified at the time of listing included competition and displacement by other nonnative plant species, seed predation by Owyhee harvester ants, development, and habitat fragmentation and isolation of small populations (USFWS 2016, p. 55061).

More recently, the 2020 SSA reaffirmed the loss and degradation of sagebrush steppe habitat, primarily due to the increased frequency and intensity of wildfire and the introduction and spread of invasive species as the primary threats driving the status of the species. These threats not only reduce the habitat available for slickspot peppergrass but also lead to secondary consequences that further decrease the species' viability. Secondary consequences may include the proliferation of Owyhee harvester ants, which prey on the seeds of slickspot peppergrass, and the fragmentation and isolation of slickspot peppergrass populations, which can hinder insect-facilitated genetic exchange between populations via pollination.

Although wildfire has historically been a natural occurrence in sagebrush steppe habitats, areas that currently contain slickspot peppergrass are at heightened risk of unnaturally large or frequent catastrophic wildfires due to fuel loads created by invasive plant species such as cheatgrass. Invasive plants can more readily establish after disturbances affecting natural soil biocrusts. Sofaer et al. (2022, entire) examined the interplay between wildfire incidence and the prevalence of cheatgrass in ecosystems, highlighting the increased invasiveness of cheatgrass after wildfires, altering plant community composition and increasing wildfire frequency, thereby perpetuating the cycle of invasion. The SSA states that 86 percent of EOs contain moderate, serious, or extreme levels of nonnative plant disturbance and 31 percent have serious or extreme levels of wildfire disturbance (USFWS 2020, p. 119). The complex interplay of threats is further compounded by warmer temperature regimes and changes in precipitation, creating a feedback loop in which increased wildfires foster conditions that favor invasive species, which in turn heightens the likelihood of future wildfires. Furthermore, residential and commercial development, along with associated infrastructure in the Foothills and Snake River Plain regions, has directly destroyed slick spot microsites, leading to population extirpations. Such development exacerbates fragmentation, making slickspot peppergrass populations more isolated and less resilient to environmental changes.

Several Federal partners including BLM, Idaho Army National Guard (Soldier Readiness Program/Orchard Training Complex), and the U.S. Air Force (Juniper Butte Range) have developed long-term Conservation Agreements, Resource Management Plans, or Integrated

Natural Resource Management Plans. These plans are tailored to conserve slickspot peppergrass EOs and surrounding habitat on their managed lands and help direct investment towards habitat protection and restoration. The formation of Rangeland Fire Protection Associations (RFPAs) in Idaho has increased the response capacity of agencies and local communities to fire starts, as these associations now work in tandem with State and Federal wildfire fighting resources. Additionally, BLM continues to explore effective fuel break techniques that contribute to the ongoing development of best management practices to reduce impacts and protect the species. Wildfire management activities are crucial to addressing the landscape-scale context of threats to the species. Thus, addressing these interconnected threats through comprehensive management strategies and dual-purpose tools will be essential for the recovery of slickspot peppergrass.

New research investigating the genomic origin, evolution, and phylogeography of slickspot peppergrass suggests that reduced fecundity in slickspot peppergrass populations may be an emerging threat affecting the species (Buerki et al. 2026, entire). Additional research is needed to explore whether reduced fecundity is being driven by inbreeding depression or genomic rearrangements (a change in the structure of the species genome) or a combination of both. This research suggests that reduced fecundity may be acting as another synergistic mechanism affecting species viability.

Other activities may pose variable impacts to slickspot peppergrass. For example, livestock staging or trailing within slick spots when soils are wet may affect the seedbank or disturb soil crusts, which can cause irreversible damage to slick spots. Additionally, concentrations of livestock or wild ungulates in areas such as near water troughs, livestock feeding sites, or along fence lines that coincide with actively growing and flowering plants may kill individual plants. However, livestock grazing can also have beneficial effects for species conservation by reducing the number of invasive nonnative plants on the landscape. When livestock use, duration, stocking rates, and locations are managed in coordination with slickspot peppergrass conservation efforts, livestock grazing has shown potential as a tool to assist in the reduction of wildfire risks within the Great Basin.

II. RECOVERY

A. Recovery Strategy

The recovery strategy provides a concise overview of the envisioned recovered state for slickspot peppergrass, describes the Service's chosen approach to achieve it, and includes the rationale for why the approach was chosen. Specifically, the recovery strategy articulates how the plan's statutory elements (e.g., recovery criteria, recovery actions, and estimates of time and cost) will work together to achieve slickspot peppergrass recovery. The recovery strategy for slickspot peppergrass is based on the conservation principles of resiliency, redundancy, and representation (Shaffer and Stein 2000, pp. 307–310; Wolf et al. 2015, entire; Smith et al. 2018, entire).

Resiliency describes the ability of populations to withstand stochastic events (events arising from random factors). **Representation** describes the ability of a species to adapt to changing environmental conditions. **Redundancy** describes the ability of a species to withstand catastrophic events. Generally, a species with a high degree of resiliency, redundancy, and representation is better able to respond and adapt to demographic and stochastic conditions and is more likely to persist over time.

Our vision for recovering slickspot peppergrass is to demonstrate the persistence of secure populations of slickspot peppergrass across the species' range (Foothills, Snake River Plain, Jarbidge). Suitable slickspot peppergrass habitat should consist of slick spots surrounded by a sagebrush overstory mixture of Wyoming and basin big sagebrush (*Artemisia tridentata*, ssp. *wyomingensis* and ssp. *tridentata*), rabbitbrush (*Chrysothamnus* spp.), antelope bitterbrush (*Purshia tridentata*), an understory of native perennial bunchgrasses of various sizes, a diversity of native annual and perennial flowering forbs, a biological soil crust, and healthy pollinating insect populations. Continuous and adaptive active management of habitat and threats during the recovery process should have alleviated the scale and frequency of threats from invasive species and current fire regimes. Wildfires will occur, but resiliency of the species and surrounding habitat should prevent a decline in the overall slickspot peppergrass population over the long-term. Ecological processes such as pollination and maintenance of robust native plant diversity should support the species.

The strategy to achieving our recovery vision for slickspot peppergrass is to improve resiliency across the species' range by managing and protecting EOs and adjacent areas. Although the threats of invasion by non-native plants and of increased wildfire are operating at much larger ecosystem scales than the range of slickspot peppergrass, active management and conservation by land managers and landowners to reduce these and other threats in and adjacent to EOs can curb their localized effects such that EOs will demonstrate improved resiliency as measured by stable or improving EO rankings. Recovery Criterion 1 (Slickspot peppergrass habitat on Federal land is protected by established Conservation Agreements or Management Plans and is

accessible to monitoring, research, and restoration in these areas) ensures that the species is actively managed on Federal land through conservation and management agreements that will reduce threats for approximately 87% of the acreage of known EOs, while Recovery Criterion 2 (Slickspot peppergrass demonstrates improved resiliency and maintains range-wide redundancy as determined by the persistence of a minimum of 100 EOs across its range during a 12-year period, with at least 75 EOs exhibiting fair to excellent viability (A-C rank) and the remainder of EOs exhibiting any condition of A through D) specifies the number of EOs that should achieve sustained improvement to demonstrate threat alleviation. Recovery actions to improve resiliency include working with Federal land managers and private or municipal landowners to conserve and manage the species and its habitat, mapping and monitoring EO condition, refining and promoting consistency in data collection, conducting research to guide conservation techniques and threat abatement, and conducting outreach and education to stimulate conservation of slickspot peppergrass and the sagebrush steppe ecosystem.

The recovery strategy will also maintain redundancy of the species across its range at approximately its current number of EOs. This number of EOs, spread across the Foothills, Snake River Plain, and Jarbidge areas, is sufficient to ensure the long-term persistence of the species assuming resiliency can be improved for the majority of them. The loss of a small number of EOs may be unavoidable during the initial period of recovery while mechanisms to lessen threats are still being developed, tested, and implemented. Recovery Criterion 2, which specifies the number of EOs that should achieve sustained improvement, will focus recovery efforts on the moderate to higher quality EOs (A through C) because these populations will best support the long-term persistence of the species, while also recognizing that poorer viability EOs (CD and D rank) can contribute to redundancy in a variety of ways such as creating stepping stones for pollinators or by plants harboring genetic diversity that can be utilized in out-planting trials. Recovery actions to support redundancy are the same actions that support resiliency, as well as conducting research to explore seeding or out-planting techniques to bolster existing populations or start new populations if conditions warrant this approach to achieve adequate redundancy.

Finally, the recovery strategy focuses on preserving representation of the species by maintaining the ecological and genetic diversity of EOs across the species' geographic (i.e., Foothills, Snake River Plain, and Jarbidge) and phylogenetic range. Recovery criteria 1 and 2 ensure the species will be secure across its range, thereby fostering ecological and genetic diversity, while Recovery Criterion 3 (A secure stock of slickspot peppergrass seed and tissue is maintained to preserve representation and available as a source of plant material for restoration and research) will ensure that slickspot peppergrass seeds and tissue are maintained and available for restoration and research, allowing us to fill information gaps about the species, maintain its adaptive capacity, and maximize our conservation techniques. Recovery actions that support resiliency and redundancy will also contribute to maintaining representation of the species.

Furthermore, we anticipate representation will be improved by developing tissue culture techniques for research and field planting, and planning and implementing a seed and tissue storage bank.

Recovering the species within 30 years is attainable depending on budgetary constraints and opportunities based on the full implementation and schedule of actions in this recovery plan.

B. Recovery Criteria

Recovery criteria are statutorily required objective, measurable descriptions of a recovered state for slickspot peppergrass, as described in 4(f)(1)(b)(ii) of the Act. Recovery criteria describe the conditions of resiliency, redundancy, representation, and threat abatement that indicate when slickspot peppergrass may no longer meet the Act's definitions of an endangered species or threatened species. Recovery criteria present our best estimate of a species' recovered condition at the time of recovery plan development. Changes in available information, technologies, and our understanding of the species over time might mean that the recovered state envisioned by the recovery criteria differs from our assessment in a later status determination.

The slickspot peppergrass may be considered for delisting when the following conditions are met:

Criterion 1: Slickspot peppergrass habitat on Federal land is protected by established Conservation Agreements or Management Plans and is accessible to monitoring, research, and restoration in these areas.

Justification: Approximately 87 percent (14,182 acres, 5,739 ha) of the slickspot peppergrass EO acreage range-wide occurs on Federal lands. Formal agreements and management plans with our Federal partners to conserve EOs and surrounding habitat establish regulatory mechanisms to protect existing populations of slickspot peppergrass and direct investment towards habitat protection, stabilization, and restoration. Access to slickspot peppergrass habitat provides the continued opportunity to assess viability of EOs, implement best management practices, explore research questions, and improve sagebrush steppe habitat in the landscape surrounding slickspot peppergrass occurrences by reducing the threat of wildfire and invasive species. EOs located on lands managed by the BLM, Idaho Army National Guard (Soldier Readiness Program/Orchard Training Complex), and the U.S. Air Force (Juniper Butte Range) are managed by long-term Conservation Agreements, Resource Management Plans, or Integrated Natural Resource Management Plans. These plans are tailored to the specific needs of slickspot peppergrass conservation, aligning with this recovery plan.

Criterion 2: Slickspot peppergrass demonstrates improved resiliency and maintains range-wide redundancy as determined by the persistence of a minimum of 100 EOs across its range during a

12-year period, with at least 75 EOs exhibiting fair to excellent viability (A-C rank) and the remainder of EOs exhibiting any condition of A through D.

Justification: Achieving and maintaining a numerous distribution of populations in fair to excellent condition can serve as a surrogate measure that threats to slickspot peppergrass are lessening sufficiently to indicate improving resiliency across the range of the species. Conservation of fair to excellent condition EOs (A through C) is of greatest importance to support the resiliency of the species because these areas are more likely to be strongholds for the species, supporting larger numbers of slickspot peppergrass within areas of more robust plant and pollinator diversity and are more likely to result in sustained improvement in response to conservation effort and investment. Poorer viability EOs (CD and D rank) may also play a role in ensuring redundancy and representation but should make up a much smaller portion of the EOs contributing to recovery compared to higher quality EOs. These poorer viability areas may serve as temporary stepping-stones for pollinators moving between plant populations or may harbor genetic diversity relevant to ongoing conservation efforts. However, lower ranked EOs may not occur in areas where significant resources should be allocated if the likelihood of sustaining improvements is low given surrounding landscape conditions. Based on the 2024 count of 68 A-C ranked EOs, recovery may be achieved by improving the condition of at least 7 lower-viability EOs (from a CD or D rank to C rank or higher) that present the best opportunity for sustained improvement, while maintaining all existing A-C ranked EOs. Alternatively, any new EOs that are identified or EOs that are established by out-planting or transplanting can contribute to achieving this criterion.

During the recovery process individual EO ranks may fluctuate (e.g., from a BC to a C during two different survey years); the criterion allows for this fluctuation while ensuring that the species is demonstrating fair to excellent viability within a majority of EOs collectively across its range over time. The minimum number of EOs (100) specified in Criterion 2 acknowledges the potential loss of a small number of EOs during the recovery process (based on 115 EOs currently documented) as we continue to explore methods to lessen and ameliorate threats. The recovery strategy recognizes that the number of EOs that currently occur is generally sufficient to recover the species across its range if resiliency can be improved through threat alleviation to ensure long-term persistence. Because more than 100 EOs may continue to persist until recovery is achieved, conservation efforts should focus, at minimum, on the 100 EOs that provide the best aggregate of resiliency, redundancy, and representation across the range. This criterion does not recommend specific numbers of EO condition rankings by geographic or phylogenetic area. Given the potential implications of current research (i.e., Buerki et al. 2026), we anticipate that our conceptual management approach may shift from geographic areas to phylogenetic groupings. Regardless, the intent of this criterion is to maintain and restore EOs across the species' range while providing flexibility to engage in conservation efforts as partners and resources are available and as new information compels efforts in specific geographic areas or

phylogenetic groups. Conservation of slickspot peppergrass on Federal or private land may contribute to achieving this criterion.

The criterion incorporates a 12-year period to verify that populations are maintaining or improving resiliency based in part on the maximum timespan of seed viability in the seed bank, as only a portion of the persistent seed bank germinates in any given year, and seeds have been found to be viable for at least 12 years. Therefore, a 12-year period allows for a full expression of the seed bank as the species is demonstrating improving resiliency. Based on the current frequency of monitoring and assessing EOs range-wide at least every 3 years, a 12-year period ensures that multiple cycles of monitoring data demonstrate stable or improving trends, signaling that threats to the species are diminishing. Multiple cycles of survey information can help interpret the inherent variability typical of annual plants due to climatic factors such as timing and extent of rainfall within the species' range or impacts from other stochastic events and stressors that are likely to occur. Therefore, if surveys document that at least 75 EOs are exhibiting fair to excellent condition but subsequently the number of EOs in fair to excellent condition temporarily drops below 75 during a subsequent survey year, this may reflect condition fluctuations due to natural factors such as precipitation and may not necessarily mean this criterion is not being met; additional surveys during at least a 12-year period can help to substantiate whether the EOs are demonstrating fair to excellent condition. If significant fluctuations in EO conditions are occurring from one survey to the next, a period longer than 12 years may be necessary to determine that threats are sufficiently alleviated.

Criterion 3: A secure stock of slickspot peppergrass seed and tissue is maintained to preserve representation and available as a source of plant material for restoration and research.

Justification: Our understanding of the ecological, genetic, phylogenetic, and morphological diversity of the species is incomplete, resulting in off-site preservation of slickspot peppergrass serving an important role in preserving the representation and adaptive capacity of the taxon. Seed and tissue collection should be representative of genetic diversity across the species' range. Experts should develop a plan identifying specific sources of seed and tissue based on genetic analysis and habitat factors; quantities of seed and tissue needed for initial collections and continuing maintenance; and methods to handle, store, and use the material. Tissue may be used for genetic tests and tissue culture research to produce plants for propagation, and the supply of seed, seedlings, and tissue culture-derived plants may be used for research and restoration of depleted EOs. It is essential to maintain these stocks during the recovery process and even after delisting, or for as long as necessary, depending on threats present at the time of delisting.

III. RECOVERY ACTIONS

Recovery actions are the statutorily required, site-specific management actions needed to achieve recovery criteria, as described in section [4\(f\)\(1\)\(B\)\(i\)](#) of the Act. The Service assigns recovery action priority numbers (1-3) to rank recovery actions. 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. Recovery action priority numbers are based on the following:

Priority 1: An action that must be taken to prevent extinction or to prevent the species from declining irreversibly.

Priority 2: An action that must be taken to prevent a significant decline in species population/habitat quality, or some other significant negative impact short of extinction.

Priority 3: All other actions necessary to provide for full recovery of the species

The recovery actions recommended in this recovery plan will, if implemented, lessen and alleviate threats to the species (Table 1). Although threats may never be entirely eliminated across the broader landscape within which slickspot peppergrass occurs, implementation of recovery actions should reduce the severity and frequency of threats such that the protections of the Act are no longer needed for the species.

Five broad categories of recovery actions are recommended to recover slickspot peppergrass:

- Continue to implement existing conservation agreements and land management plans with our Federal partners. Engage private and municipal landowners, and Federal partners without existing agreements, to negotiate access for survey and research purposes and/or to develop new conservation agreements to protect existing habitat and support species conservation and recovery (actions 1-3).
- Continue to map, survey, and monitor EOs to confirm condition of EOs and guide managing for resiliency. Refine EO definitions, protocols, and related habitat data to promote consistency in data collection that reflects current information, technologies, and our understanding of the species (actions 4-6).
- Conduct research on species biology and effectiveness of management methods to guide best management practices aimed at minimizing threats (actions 7-16).
- Collect and preserve tissue and seeds in a conservation bank to improve resiliency, redundancy, and representation of the species (actions 17-19).
- Coordinate across existing programs and conduct public outreach and education to raise awareness, foster community involvement, and promote stewardship practices (actions 20-24).

Within these categories, site-specific actions are prioritized to contribute to the successful implementation of slickspot peppergrass conservation and recovery efforts (Table 2). A RIS serves as a further step down of activities that contribute to accomplishing recovery actions; the RIS will be updated as a stand-alone document as emerging information about the species' biology, threats, and status fluctuates over time. Actions and activities should be implemented in strategic order rather than the order in which they may be listed.

Table 1: Crosswalk of listing factors to slickspot peppergrass recovery criteria and recovery actions.

Listing Factor - Threat Factor (abridged)	Recovery Criteria #	Recovery Actions
		Implement Land Management Practices and Conservation Agreements
A- Destruction of habitat and loss of range C- Disease or predation	1, 2, 3	1. Continue to cooperate with the BLM on their existing and future Conservation Agreement and/or Resource Management Plans, and with the Idaho Army National Guard and U.S. Air Force on their Integrated Natural Resource Management Plans, to conserve existing EOs and apply best management practices that decrease risk of wildfire and prevent/slow invasive species in the geographic areas managed by these agencies.
A- Destruction of habitat and loss of range C- Disease or predation	1, 2, 3	2. Apply best management practices for maintaining or, where necessary, restoring sagebrush steppe habitat within and adjacent to slickspot peppergrass EOs. For restoration efforts, emphasize the use of native shrubs, grasses, and forbs to benefit the species and its insect pollinators.
A- Destruction of habitat and loss of range	2	3. Engage private and municipal landowners in slickspot peppergrass conservation, including developing conservation agreements and negotiating access for survey and research purposes in or near existing or newly identified EOs.
		Map, Survey, and Monitor EOs of Slickspot Peppergrass
A- Destruction of habitat and loss of range	1, 2	4. Refine EO definitions and related habitat maps across the range of slickspot peppergrass.
A- Destruction of habitat and loss of range	1, 2	5. Survey and monitor all EOs and conduct Habitat Inventory and Population (HIP) assessments at least every 3 years using consistent survey protocols. Utilize survey data to define and rank EO conditions, census populations, and issue a report every 3 years of the findings.
A- Destruction of habitat and loss of range	1, 2	6. Adopt standardized range-wide protocols for monitoring and assessing habitat improvement or restoration.

Slickspot Peppergrass Recovery Plan

Listing Factor - Threat Factor (abridged)	Recovery Criteria #	Recovery Actions
		Conduct Research on Species Biology and Effectiveness of Management Methods
A-Destruction of habitat and loss of range	2, 3	7. Conduct research on slickspot peppergrass genomics and phylogenetics to inform and prioritize slickspot peppergrass EOs essential for maintaining genetic diversity and local adaptations of the species into the future.
A-Destruction of habitat and loss of range	1, 2	8. Conduct research into use of fuel break techniques that are consistent with conservation of slickspot peppergrass, explore other methods for protecting slickspot peppergrass from wildfire, and develop best management practices to reduce impacts to EOs.
A- Destruction of habitat and loss of range	1, 2	9. Conduct research on effects of fire, including prescribed burns, on slickspot peppergrass and develop best management practices to protect the species.
A-Destruction of habitat and loss of range	1, 2	10. Conduct research on livestock grazing regimes to coordinate livestock use, duration, stocking rates, and locations with slickspot peppergrass conservation efforts and develop grazing practices that support reduction of wildfire.
A-Destruction of habitat and loss of range. C-Disease or predation	1, 2	11. Implement best management practices to reduce impacts from Owyhee harvester ants on slickspot peppergrass.
A-Destruction of habitat and loss of range. C-Disease or predation	1, 2	12. Conduct research and field trials on slickspot peppergrass plantings to support population reestablishment or enhancement (e.g., seeding or containerized planting).
A-Destruction of habitat and loss of range. C-Disease or predation	1, 2, 3	13. Conduct research to determine why slickspot peppergrass is only found on some slick spots and not others (e.g., soil chemistry, soil biology, or other factors).

Slickspot Peppergrass Recovery Plan

Listing Factor - Threat Factor (abridged)	Recovery Criteria #	Recovery Actions
A-Destruction of habitat and loss of range.	1, 2	14. Conduct research regarding habitat connectivity between slickspot peppergrass EOs, including the role of individual genetic uniqueness and local adaptation, insect pollinators, and seed dispersal systems, and develop best management practices to facilitate genetic interchange.
A-Destruction of habitat and loss of range	1, 2	15. Conduct research to understand the habitat requirements of slickspot peppergrass pollinators in the vicinity of EOs and develop best management practices for pollinator management.
A-Destruction of habitat and loss of range.	1, 2	16. Conduct research on effects of off-road recreation on slickspot peppergrass occurrences and develop best management practices to protect the species from this threat.
		Collect and Preserve Tissue and Seeds in a Conservation Bank
A-Destruction of habitat and loss of range	2, 3	17. Determine tissue culture techniques for propagating slickspot peppergrass to provide material for genetic research and field planting.
A-Destruction of habitat and loss of range	2, 3	18. Prepare a plan for maintaining a seed and tissue collection program and store slickspot peppergrass seed and tissue at a secure conservation bank(s).
A-Destruction of habitat and loss of range.	3	19. Conduct research to determine the viability period of seeds and plant material, in the wild and in storage, including in the conservation bank(s).
C-Disease or predation		Coordinate Across Existing Programs and Conduct Public Outreach and Education
A- Destruction of habitat and loss of range	1, 2, 3	20. Maintain a Slickspot Peppergrass Technical Team to provide technical expertise and coordinate conservation efforts.

Slickspot Peppergrass Recovery Plan

Listing Factor - Threat Factor (abridged)	Recovery Criteria #	Recovery Actions
A-Destruction of habitat and loss of range. C-Disease or predation	1, 2, 3	21. Encourage partners to incorporate goals identified in the National Seed Strategy for Rehabilitation and Restoration ¹ into slickspot peppergrass restoration plans and projects.
A-Destruction of habitat and loss of range	1, 2	22. Encourage Federal and non-Federal landowners to develop non-native invasive plant control plans and encourage use of novel sagebrush steppe habitat enhancement options related to seed selection, recruitment, and delivery such as use of seed pillows, collection of locally adapted native shrub, grass, forb seed for seed grow out programs, or planting of forb islands for enhancement of native vegetation within and adjacent to slickspot peppergrass and in connectivity corridors.
A-Destruction of habitat and loss of range	1, 2	23. When and where applicable, coordinate sagebrush habitat protection and restoration efforts with greater sage grouse habitat improvement plans and agreements.
A-Destruction of habitat and loss of range. C-Disease or predation	1, 2, 3	24. Develop outreach and educational materials to foster slickspot peppergrass conservation and reduce threats to the sagebrush steppe ecosystem.

¹ Plant Conservation Alliance. 2015. "National Seed Strategy for Rehabilitation and Restoration, 2015-2020." Bureau of Land Management. Available at <https://www.blm.gov/programs/natural-resources/native-plant-communities/national-seed-strategy>

IV. TIME AND COST ESTIMATES

Estimates of time and cost, as defined in section [4\(f\)\(1\)\(B\)\(iii\)](#) of the Act, must reflect, to the maximum extent practicable, the total amount of time and costs it will take to achieve the recovery (delisting) of slickspot peppergrass. The cost estimates provided do not account for possible future inflation.

The Service anticipates working with a broad range of partners to implement conservation and recovery actions for slickspot peppergrass, including Federal and State agencies, Tribes, local governments and communities, private landowners, academia, and non-governmental organizations. The Service and any partner may contribute funds to the recovery effort. The recovery plan does not commit the Service or any partner to carry out recovery actions or expend the estimated funds, nor does it ensure allocation of funds to implement these actions. The Act mandates that recovery plans include an estimate of the cost to recover species but does not commit the allocation of funds. Implementation of recovery actions for slickspot peppergrass may benefit other listed and non-listed species dependent on sagebrush steppe ecosystems.

Full implementation of slickspot peppergrass recovery actions is expected to improve the status of the species so it can be delisted within 30 years following the adoption of this recovery plan. The cumulative cost of recovery is estimated at \$8,829,000, for an average annual cost of approximately \$294,300 (Table 2). Estimating the cost of recovery implementation includes uncertainties such as: (1) the emergence of new threats, (2) the response of species to management, (3) innovations in methods / technologies to address threats, and (4) potential economies of scale. Costs incorporate planning, design, implementation, research, monitoring, and evaluation associated with specific actions. Costs are based on current prices for equipment, services, and personnel and may change as efforts to recover the species continue.

Employing adaptive management principles will ensure that management actions and tools are effectively ameliorating threats to the species and meeting the objectives of this recovery plan. If the actions and tools are not effective, changes in management should be made and additional planning and research may be necessary. We acknowledge that the timeframe estimated to implement the recovery actions and achieve recovery of the species may take longer than expected. The recovery of slickspot peppergrass will depend largely on the commitment and the ability of the Service and partners to implement recovery actions and reduce threats to the species.

Table 2: Recovery actions, priority, and estimated costs (in fiscal year 2025 dollars) for slickspot peppergrass.

Recovery Actions	Priority*	Estimated Cost
Implement Land Management Practices and Conservation Agreements		
1. Continue to cooperate with the BLM on their existing and future Conservation Agreement and/or Resource Management Plans, and with the Idaho Army National Guard and U.S. Air Force on their Integrated Natural Resource Management Plans, to conserve existing EOs and apply best management practices that decrease the risk of wildfire and prevent/slow invasive species in the geographic areas managed by these agencies.	1	Cost likely to be absorbed under existing programs.
2. Apply best management practices for maintaining or, where necessary, restoring sagebrush steppe habitat within and adjacent to slickspot peppergrass EOs. For restoration efforts, emphasize the use of native shrubs, grasses, and forbs to benefit the species and its insect pollinators.	1	\$3,000,000
3. Engage private and municipal landowners in slickspot peppergrass conservation, including developing conservation agreements and negotiating access for survey and research purposes in or near existing or newly identified EOs.	2	\$74,000
Map, Survey, and Monitor EOs of Slickspot Peppergrass		
4. Refine EO definitions and related habitat maps across the range of slickspot peppergrass.	2	\$97,000
5. Survey and monitor all EOs and conduct HIP assessments at least every 3 years using consistent survey protocols. Utilize survey data to define and rank EO conditions, census populations, and issue a report every 3 years of the findings.	2	\$750,000
6. Adopt standardized range-wide protocols for monitoring and assessing habitat improvement or restoration.	2	\$198,000

Recovery Actions	Priority*	Estimated Cost
Conduct Research on Species Biology and Effectiveness of Management Methods		
7. Conduct research on slickspot peppergrass genomics and phylogenetics to inform and prioritize slickspot peppergrass EOs essential for maintaining genetic diversity and local adaptations of the species into the future.	1	\$150,000
8. Conduct research into use of fuel break techniques that are consistent with conservation of slickspot peppergrass, explore other methods for protecting slickspot peppergrass from wildfire, and develop best management practices to reduce impacts to EOs.	1	\$1,230,000
9. Conduct Research on effects of fire, including prescribed burns, on slickspot peppergrass and develop best management practices to protect the species.	2	\$1,000,000
10. Conduct Research on livestock grazing regimes to coordinate livestock use, duration, stocking rates, and locations with slickspot peppergrass conservation efforts and develop grazing practices that support reduction of wildfire.	2	\$50,000
11. Implement best management practices to reduce impacts from Owyhee harvester ants on slickspot peppergrass.	2	\$600,000
12. Conduct research and field trials on slickspot peppergrass plantings to support population reestablishment or enhancement (e.g., seeding or containerized planting).	2	\$225,000
13. Conduct research to determine why slickspot peppergrass is only found on some slick spots and not others (e.g., soil chemistry, soil biology, or other factors).	3	\$50,000

Slickspot Peppergrass Recovery Plan

Recovery Actions	Priority*	Estimated Cost
14. Conduct research regarding habitat connectivity between slickspot peppergrass EOs, including the role of individual genetic uniqueness and local adaptation, insect pollinators, and seed dispersal systems, and develop best management practices to facilitate genetic interchange.	2	\$130,000
15. Conduct research to understand the habitat requirements of slickspot peppergrass pollinators in the vicinity of EOs and develop best management practices for pollinator management.	2	\$80,000
16. Conduct research on effects of off-road recreation on slickspot peppergrass occurrences and develop best management practices to protect the species from this threat.	2	\$50,000
Collect and Preserve Tissue and Seeds in a Conservation Bank		
17. Determine tissue culture techniques for propagating slickspot peppergrass to provide material for genetic research and field planting.	2	\$75,000
18. Prepare a plan for maintaining a seed and tissue collection program and store slickspot peppergrass seed and tissue at a secure conservation bank(s).	1	\$600,000
19. Conduct research to determine the viability period of seeds and plant material, in the wild and in storage, including in the conservation bank(s).	2	\$450,000
Coordinate Across Existing Programs and Conduct Public Outreach and Education		
20. Maintain a Slickspot Peppergrass Technical Team to provide technical expertise and coordinate conservation efforts.	3	Cost likely to be absorbed under existing programs.
21. Encourage partners to incorporate goals identified in the National Seed Strategy for Rehabilitation and Restoration into slickspot peppergrass restoration plans and projects.	3	Cost likely to be absorbed under existing programs.

Slickspot Peppergrass Recovery Plan

Recovery Actions	Priority*	Estimated Cost
22. Encourage Federal and non-Federal landowners to develop non-native invasive plant control plans and encourage the use of novel sagebrush steppe habitat enhancement options related to seed selection, recruitment, and delivery such as use of seed pillows, collection of locally adapted native shrub, grass, forb seed for seed grow out programs, or planting of forb islands for enhancement of native vegetation within and adjacent to slickspot peppergrass and in connectivity corridors.	3	Cost likely to be absorbed under existing programs.
23. When and where applicable, coordinate sagebrush habitat protection and restoration efforts with greater sage-grouse habitat improvement plans and agreements.	3	Cost likely to be absorbed under existing programs.
24. Develop outreach and educational materials to foster slickspot peppergrass conservation and reduce threats to the sagebrush steppe ecosystem.	3	\$20,000

V. LITERATURE CITED

- Buerki, S., M. Geisler, P. Martinez, J. Beck, and I. Roberston. 2026. Genomics and phylogenetics inform a species recovery plan for a threatened allopolyploid plant. *Botanical Journal of the Linnean Society*. 17 pp.
- Colket, B., S. Cooke, and M. Mancuso. 2006. Element Occurrence review and update for slickspot peppergrass (*Lepidium papilliferum*). Idaho Department of Fish & Game report to U.S. Fish and Wildlife Service. 45 pp. plus appendices.
- Kinter, C.L. and J.J. Miller. 2016. Assessment of *Lepidium papilliferum* (slickspot peppergrass) Element Occurrences. Idaho Natural Heritage Program, Idaho Department of Fish and Game, Boise. 71 pp. plus appendices.
- Mansfield, D.H. and L. Barbour. 2022. Morphological variation in the rare Idaho endemic, *Lepidium papilliferum* (Brassicaceae) and segregation of Owyhee County populations as a new variety of *Lepidium montanum*. *Phytoneuron* 2022-46: 1–20. Published 17 October 2022. ISSN 2153 733X. <https://www.phytoneuron.net/wp-content/uploads/2022/10/46PhytoN-Lepidiumpapilliferum.pdf>.
- Miller, J. J. and C. L. Kinter. 2024. Field Assessment of *Lepidium papilliferum* (slickspot peppergrass) Element Occurrences: 2016 to 2022. Idaho Department of Fish & Game report to U.S. Fish and Wildlife Service. 69 pp. plus appendices.
- NatureServe. 2002. Element Occurrence Data Standard. NatureServe, Arlington, Virginia. 201 pp.
- [NMFS and USFWS] National Marine Fisheries Service and U.S. Fish and Wildlife Service. 2018. Interim recovery planning guidelines. Version 1.4. 122 pp.
- Robertson, I.C. and W.G. Robertson. 2020. Colony dynamics and plant community associations of the harvester ant, *Pogonomyrmex salinus* (Hymenoptera: Formicidae) in sagebrush-steppe habitat. *Environmental Entomology* 49(4): 983-992.
- Shaffer, M.L. and B.A. Stein. 2000. Safeguarding our precious heritage. Pp. 301-321 in: *Precious heritage: The status of biodiversity in the United States*, Eds. B. A. Stein, L. S. Kutner, and J. S. Adams. New York, New York: Oxford University Press. 399 pp.
- Sofaer, Helen R., Catherine S. Jarnevich, Erin K. Buchholtz, Brian S. Cade, John T. Abatzoglou, Cameron L. Aldridge, Patrick J. Comer, Daniel Manier, Lauren E. Parker, and Julie A. Heinrichs. 2022. Potential cheatgrass abundance within lightly invaded areas of the Great Basin. *Landscape Ecology* 37(10): 2607-2618.

- Smith, D.R., N.L. Allan, C.P. McGowan, J.A. Szymanski, S.R. Oetker, and H.M. Bell. 2018. Development of a Species Status Assessment process for decisions under the U.S. Endangered Species Act. *Journal of Fish and Wildlife Management* 9:302-320: e1944-687X. doi:10.3996/052017-JFWM-041.
- [USFWS] U.S. Fish and Wildlife Service. 2009. Endangered and threatened wildlife and plants; Listing *Lepidium papilliferum* (slickspot peppergrass) as a threatened species throughout its range. *Federal Register* 74:52014-52064. October 8, 2009.
- [USFWS] U.S. Fish and Wildlife Service. 2016. Endangered and threatened wildlife and plants; Threatened status for *Lepidium papilliferum* (slickspot peppergrass) throughout its range. *Federal Register* 81:55058-55084. August 17, 2016.
- [USFWS] U.S. Fish and Wildlife Service. 2020. Species Status Assessment of *Lepidium papilliferum* (slickspot peppergrass), Version 1.0. Idaho Fish and Wildlife Office, U.S. Fish and Wildlife Service, Boise, Idaho. February 2020. 157 pp. + appendices.
- [USFWS] U.S. Fish and Wildlife Service. 2023. Endangered and threatened wildlife and plants; Designation of critical habitat for slickspot peppergrass (*Lepidium papilliferum*). *Federal Register* 88:28874-28916. May 4, 2023.
- Wolf, S., B. Hartl, C. Carroll, M.C. Neel, and N. Greenwald. 2015. Beyond PVA: Why recovery under the Endangered Species Act is more than population viability. *BioScience* 65(2):200-207.

APPENDIX A. Summary of Comments Received on Draft Recovery Plan

Background

We posted a Document Notice of Availability on November 03, 2023, to announce the availability of the draft recovery plan for the slickspot peppergrass for a 60-day public review and comment period, and to solicit comments by the scientific community, State and Federal agencies, Tribal governments, and other interested parties on the information, assumptions, and conclusions presented in the draft plan. We extended the public comment period by 14 days at the request of commenters who were unable to submit their comments by the original closing date of January 2, 2024. The extended public comment period was open until January 16, 2024.

During the public comment period, we received comments from eight individuals or organizations, including responses from the Idaho Governor’s Office of Species Conservation, Idaho Army National Guard, multiple livestock and cattle organizations, and the general public. Comments received ranged from minor editorial suggestions to specific recommendations on plan content. We considered all substantive comments. Below, we provide a summary and response to substantive comments received on the draft plan, grouped by topical area. In instances where we made a direct, non-substantive revision to the plan we do not provide a summary and response below.

Management Units

Comment: The commenter(s) stated that the draft recovery plan is proposing to establish six Management Units (MUs) based on land ownership, however, the establishment of new MUs appears to be unnecessary and their purpose is unclear. The commenter specified MUs are not mentioned in either recovery criteria or proposed management actions, and the use of term “Management Units” vs geographic populations, geographic areas, and geographic regions appearing elsewhere in the document is confusing.

Response: Management Units (MUs) and related figures were removed from the recovery plan. They were redundant to existing geographic delineations and resulted in unnecessary confusion.

Distribution and Population Status

Comment: The commenter(s) stated that agencies have not followed Standard Protocols, and the data underlying the draft recovery plan is unreliable. The commenter referred to the agencies recognition of NatureServe 2002 as providing the Standard Protocols, and Colket et al. 2006 as

having applied the NatureServe protocols to Slickspot Peppergrass EOs. However, the commenter expressed the opinion that the NatureServe 2002 protocols, as applied specifically to slickspot peppergrass by Colket et al. 2006, include subjective, not objective, descriptors. Specifically, the commenter indicated the scoring system is subjective and does not take into consideration other factors that should be considered in determining management priorities for EOs, population sustainability, and high value areas for protection and management. The commenter indicated that the condition of the EOs was not accurately reported, and instead the conditions of the uplands immediately adjacent to the EOs were (purportedly) reported. Furthermore, they suggest that because the adjacent uplands were more invaded by introduced, invasive nonnative species, which the EOs themselves were primarily free of, or had low occurrence of, non-native species, the rankings are consistently biased toward poorer conditions. The commenter recommended that the technical team reevaluate the scoring system and adjust it to consider long-term population viability, not just individual EOs.

Response: EOs are identified for slickspot peppergrass by grouping together occupied slick spot microsites and the surrounding plant communities that occur within 0.6 miles (1 kilometer) of each other (USFWS 2020, p. 7). Due to the nature of the definition, individual EOs may differ greatly in size based on whether there are many occupied slick spots distributed widely across the landscape relatively close to one another (which would comprise a single, large EO), or whether there are only a few (or even a single) slick spot(s) that occur close together but are relatively isolated from other occupied slick spots (which would comprise a single, small EO). This definition can lead to variation in how EOs are reported based on their size. At the current time, EO delineation and ranking provide the best available information on habitat condition, surrounding landscape context, and species abundance.

Reporting EO-adjacent invasive nonnative species could help inform recovery actions, given the complex interplay of wildfire and invasive species as a threat, combined with the fact that broadscale eradication methods for controlling these threats have not been developed. By considering the adjacent uplands when assessing habitat condition, the current protocol incorporates potential invasive species that could colonize the slick spot when the conditions are adequate, such as after disturbance or wildfire. Addressing the interconnected threats of nonnative species invasion and increasing frequency and intensity of wildfire through comprehensive management strategies will be essential for the recovery of slickspot peppergrass.

The recovery plan includes recovery actions to continue to map, survey, and monitor EOs to confirm condition of EOs and refine EO definitions, protocols, and related habitat data. These actions will promote consistency in data collection to ensure that current information and techniques steer the recovery effort (recovery actions 4-6). The Recovery Implementation Strategy (RIS) will promote consistency by identifying the specific methods and techniques that may be used by partners during the implementation of activities that support recovery actions.

Threats

Comment: The commenter stated that the draft recovery plan does not adequately address how to improve conditions for slickspot peppergrass in the face of wildfire and invasive species. The commenter recommended an action to implement fuel breaks around EOs as opposed to researching vegetated fuel breaks and highlighted the positive impact the Rangeland Fire Protection Associations (RFPAs) are having in limiting catastrophic wildfires within slickspot peppergrass habitat, particularly in combination with State and Federal wildfire resources.

Response: The Threats section of the recovery plan was revised to acknowledge activities that have already been implemented in support of threat alleviation and species recovery. We reference long-term Conservation Agreements, Resource Management Plans, or Integrated Natural Resource Management Plans that are tailored to conserving and restoring slickspot peppergrass EOs and surrounding habitat. We also added information about RFPAs and the Bureau of Land Managements' progress towards implementing effective fuel breaks, acknowledging that these and similar activities are crucial to addressing the landscape-scale context of threats to the species.

In addition, the recovery strategy and discussion of recovery criteria were revised to describe the conditions of resiliency, redundancy, and representation, that indicate when slickspot peppergrass may no longer meet the Act's definitions of a threatened species. The strategy includes improving resiliency across the species' range by managing and protecting EOs and adjacent areas, while acknowledging that the threat of invasion by non-native plants and of increased wildfire are operating at much larger ecosystem scales than the range of slickspot peppergrass.

Lastly, the recovery actions, if implemented, will lessen and alleviate threats to the species. Recovery actions are designed to be broad and overarching to keep the recovery plan durable and relevant over time. The RIS will be used to focus specific management approaches in specific areas depending on what is considered a best management practice at that time and place. We intend to coordinate this level of detail with partners continually through updates to the RIS to steer the most efficacious path to recovery.

Recovery Strategy

Comment: General editing is needed to connect the recovery plan's vision, strategies, criteria, and actions to create a clearer blueprint for adequately reducing threats to achieve "recovery". This document should serve to unify and organize interagency management and collaboration from willing landowners and other stakeholders to achieved standards and delist the species.

Response: The recovery strategy was revised to create a clearer connection between the recovery plan's strategy, criteria, and actions. The strategy now describes our intended approach to achieving the resiliency, redundancy, and representation needed for recovery, including how the criteria relate to each element of the strategy and which recovery actions will contribute to achieving each criterion.

Recovery Criterion 1

Comment: Commenters recommended that Criterion 1 be moved to a recovery action and replaced by a habitat health, function, and connectivity criterion. They questioned how we can ensure a conservation agreement is implemented or effective, and whether a conservation agreement in and of itself ensures a species is recovered. They also questioned how new information is incorporated into a conservation agreement and what happens to agreements once the species is recovered.

Response: We did not adopt the commenters' suggestion to move Criterion 1 to a recovery action and replace it with a criterion for habitat health, function, and connectivity because we maintain that a criterion focused on protection and management on Federal land is critical to the species recovery. The total range wide extent of known EOs is approximately 16,269 acres (6,583 ha) and approximately 87 percent of the range is Federal land (primarily U.S. Bureau of Land Management and military managed lands). Thus, formal conservation agreements or management plans with Federal agencies protect existing slickspot peppergrass occurrences across a large portion of the range (87 percent).

In addition to providing regulatory mechanisms to protect the species, these agreements provide additional significant benefits, such as focusing investment opportunities on habitat protection and restoration, facilitating a multi-partner cooperative approach to promote access to EOs for monitoring, continued research for incorporation of new information, and application of best management practices. In these ways, formal agreements promote habitat health, function, and connectivity, as recommended by the commenter.

As recovery of slickspot peppergrass progresses, we anticipate working with our partners to evaluate the efficacy of agreements over time, and update and revise them to incorporate new information and conservation approaches. Once the species is recovered, agreements may be maintained or may be revised to direct conservation efforts as needed.

Recovery Criterion 2

Comment: The commenter(s) did not support Criterion 2 because there are no existing A-Rank or B-Rank EOs in existence, the justification statement did not provide adequate support for

numerical thresholds, and the required distribution of A-D ranks appeared arbitrary and overly complicated. The commenter recommended the criterion be replaced by a focus on viability scores of “good or better”. The commenter also expressed that information about how many EOs are “enough” to sustain the species is not known. The commenter recommended we simplify this criterion.

Response: We revised criterion 2 in response to this comment to simplify its structure, increase flexibility, and strengthen its intent. We replaced the specific number of EO letter ranks (i.e., 34 rank A/AB/B/BC, 48 rank C/CD, and 25 rank D) with the specification that at least 75 EOs should be A-C rank, and the remainder of EOs exhibiting any condition of A through D. This achieves the same intention of ensuring that the majority of EOs display higher levels of resiliency and lessened threats, while simplifying the path to recovery by not requiring an overly formulaic approach. The intent of the criterion, to demonstrate improved resiliency and reduced threats, as measured by EO rankings across the range, remains the same, and now lessens the confusion around the numerical threshold for number of EOs and required distribution of EO letter ranks. We also revised the criterion to specify that improved resiliency and range-wide redundancy will be determined by the persistence of a minimum of 100 EOs, acknowledging that the potential loss of a small number of EOs may occur during the recovery process, as well as the potential for new EOs to be discovered or established. We updated the justification for this criterion in the body of the plan consistent with these revisions.

Comment: The commenter expressed concern that Recovery Criterion 2 calls for a “10-year period of stable or increasing population growth rates”, but slickspot peppergrass, like most short-lived species, can exhibit “populations with thousands of above ground plants one year may have none the next...” The commenter stated that estimates of population trend over a 10-year span has the potential to misrepresent progress toward recovery because strong fluctuations could occur in responses to precipitation. The commenter also expressed concern that basing a trend analysis on very few data points (e.g., perhaps every third year in a 10-year span) may not be sufficient to determine whether populations have increased, or threats have been alleviated. The commenter stated that trend analysis must account for variability unrelated to population status, and trend based on total population estimates may not easily serve as a metric of conservation success. Given the large weather-related fluctuation, the challenges of developing range-wide estimates, and ongoing development of analytical products, the commenter stated that USFWS should reformulate how trend is used in the recovery criteria prior to finalizing the recovery plan. Other indicators (e.g., occupancy rates) may better serve the purpose of tracking status trend.

Response: Recovery criterion 2 was revised to be a 12-year period. We selected this timeframe in part based on the maximum timespan of seed viability in the seed bank, which would allow for a full expression of the seed bank as the species is demonstrating improving resiliency. It also

allows us to include another year of survey data (assuming range wide surveys at 3-year intervals) to better assess trend. However, recognizing the variability as mentioned by the commenter, we also agree that longer timeframes may be necessary to detect trends and have added a statement to that effect.

If new methods to assess trends are developed during the recovery process they should be applied. The recovery plan does not preclude the option to reformulate how trend is measured. While the criterion does not endorse a specific trend analysis the intent is to demonstrate a stable and improving trend across the species range.

Recovery Actions

Comment: The commenter(s) expressed concern that recovery action 2, which is to apply best management practices for maintaining or, where necessary, restoring sagebrush steppe habitat within and adjacent to slickspot peppergrass, is a vague action with a large price tag. The draft recovery plan estimated recovery action 2 to cost \$3 million out of the cumulative \$6.1 million needed to recover the species. Specifically, the commenter recommended USFWS think through how to implement this recovery action and the cost for on the ground restoration.

Response: We relied on the expertise of the USFWS Partners for Fish and Wildlife Program to help estimate restoration costs, albeit with several important uncertainties and caveats. We calculated cost based on the current rankings of 68 A-C ranked EOs and the need to improve the rank of at least 7 additional EOs to have a total of 75, consistent with Recovery Criterion 2. We also relied on the SSA to estimate patch size given a patch size of at least 500 acres (202 ha) was chosen as optimal for good viability populations (USFWS 2020, p. 56). This approach focuses conservation on fair to excellent condition EOs (A through C) because they are of greatest importance to support the resiliency of the species. This does not preclude restoration of EOs in poor condition when appropriate. As described in the RIS, we expect to collaborate with partners to develop near-term strategies for reducing threats and enhancing habitat where feasible and most efficacious.

Comment: The commenter(s) recommended revision of recovery action 3.5 (revised to recovery action 11) for harvester ant research to focus on implementation of measures to eliminate ant colonies within 20 meters of EOs and study whether a greater distance of elimination should occur. The commenter(s) recommended that a higher cost would be appropriate for an action focused on implementation rather than research and as well as revising the priority number to Priority 1.

Response: Recovery action 11 was revised to focus on implementation of best management practices for harvester ant management. Research and harvester ant control studies have shown

the effects to slickspot peppergrass from harvester ants and have been used to develop effective treatments (e.g., application of Amdro granular ant bait). The specificity of eliminating ant colonies within 20 meters of EOs was not added to the recovery action, but that does not preclude this specific approach from being applied where it would be considered a best management practice. Additional specificity can be developed in the RIS in coordination with our partners to guide implementation of best management practices for harvester ant control. We revised the estimated cost for this recovery action from \$40,000 to \$600,000 to reflect a focus on implementation; we also revised this from a Priority 3 to a Priority 2 action but do not think it warrants identification as a Priority 1 action to prevent species extinction.

Comment: The commenter(s) expressed the opinion that recovery action 3.10 (revised to recovery action 16), which is to study effects of off-road recreation on slickspot peppergrass occurrences, does not adequately address the impact of rapidly increasing and unmanaged recreation within slickspot peppergrass habitat. The commenter(s) agree that this issue would benefit from further study but stated that the plan may need to take a step further in requiring the reduction of “unchecked recreation” before other uses are limited. Commenter(s) recommended land management agencies develop best management practices for mitigating the impact of recreation and funding be provided to assist with managing this risk.

Response: The intent of recovery action 16 is to promote development of best management practices to protect slickspot peppergrass from any negative effects of recreation. This recovery action does not preclude the option of reducing off-road recreation, but cannot require it, as land management agencies or private landowners have the authority to manage the uses of their land. This action promotes both further study and development of best management practices to minimize threats. As described in the RIS, we expect to collaborate with partners to develop near term strategies to reduce recreational impacts to the species where appropriate.