U.S. Fish & Wildlife Service

Recovery Plan

for

Umtanum Desert Buckwheat

(*Eriogonum codium*)

Photo: Randi Riggs/U.S. Fish and Wildlife Service/2018

Recovery Plan
for
Umtanum Desert Buckwheat
(*Eriogonum codium*)

U.S. Fish and Wildlife Service
Portland, Oregon

Approved: HUGH MORRISON Digitally signed by HUGH MORRISON Date: 2022.08.25 14:52:07 -07'00'

Acting Regional Director
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Recovery plans delineate reasonable actions needed to recover and/or protect listed species. We, the U.S. Fish and Wildlife Service (Service), publish recovery plans, sometimes preparing them with the assistance of recovery teams, contractors, State agencies, and others. Objectives of the recovery plan are accomplished, and funds made available, subject to budgetary and other constraints affecting the parties involved, as well as the need to address other priorities with the same funds.

Recovery plans do not necessarily represent the views or the official positions or approval of any individuals or agencies involved in the plan formulation, other than our own. They represent our official position only after signed by the Director or Regional Director. Recovery plans are reviewed by the public and may be subject to additional peer review before the Service adopts them as final. Recovery objectives may be attained, and funds expended contingent upon appropriations, priorities, and other budgetary constraints. Recovery plans are guidance 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.

Literature citation of this document should read as follows:

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An electronic copy of this recovery plan is available at:

https://ecos.fws.gov/ecp0/profile/speciesProfile?sId=3627

The first uses of technical terms are underlined and are defined in the glossary starting on page 24.

ACKNOWLEDGEMENTS

The recovery planning process has benefitted from the advice and assistance of many individuals, agencies, and organizations. Tara Callaway, State Recovery Coordinator at our Central Washington Fish and Wildlife Office, prepared this recovery plan. We also thank our partners who play an active role in the conservation of this species. Numerous partners have provided information through surveys and research, which has informed management and conservation efforts.

In particular, we would like to thank Heidi Newsome (Former Supervisory Wildlife Biologist at Central Washington National Wildlife Refuge Complex), Walter Fertig (Rare Plant Botanist at Washington Department of Natural Resources Natural Heritage Program), and Wendy Gibble (Rare Care Program Manager at University of Washington). We also acknowledge all researchers and field workers whose efforts and countless hours in the field have contributed to a better understanding of this species. We appreciate these efforts and look forward to continued collaboration as we refine methodologies and learn from actions implemented to support Umtanum desert buckwheat recovery.

RECOVERY PLANNING PROCESS

The Service is now using a three-part process to develop our recovery plans (see https://www.fws.gov/endangered/esa-library/pdf/RPI.pdf). This approach is intended to reduce the time needed to develop and implement recovery plans, increase recovery plan relevancy over a longer timeframe, and increase the flexibility of recovery planning documents by making them easier to modify as new information or circumstances arise. Under this process, a recovery plan includes the statutorily-required elements under section 4(f) of the Endangered Species Act (Act) (objective and measurable recovery criteria, site-specific management actions, and estimates of time and costs), along with a concise introduction and our strategy for how we plan to achieve species recovery. The recovery plan is supported by two supplementary documents: a species status assessment or species biological report, which describes the best available scientific information related to the biological needs of the species and assessment of threats; and the recovery implementation strategy, which details the particular near-term activities needed to implement the recovery actions identified in the recovery plan. Under this approach, new information on species biology or details of recovery implementation may be incorporated by updating these supplementary documents without concurrent revision of the entire recovery plan, unless changes to statutorily-required elements are necessary.

Thus, this recovery plan document is one piece of a three-part framework:

1. The **Species Status Assessment** (SSA) or **Species Biological Report** (SBR) informs the recovery plan; it describes the biology and life history needs of the subspecies, includes analysis of each species' historical and current conditions, and includes discussion of threats and conservation needs of each species. The SSA or SBR's format is structured around the conservation biology principles of resiliency, redundancy, and representation (Shaffer and Stein 2000, pp. 307-310; Smith et al. 2018, entire Wolf et al. 2015, entire). This document may be updated as needed based on new information.

2. The **Recovery Plan** contains a concise overview of the recovery strategy for the species (indicating how its recovered state will achieve redundancy, resiliency, and representation), as well as the statutorily required elements of recovery criteria, recovery actions, and estimates of the time and costs to achieve the plan's goals.

3. The **Recovery Implementation Strategy** (RIS) is the vehicle for implementing the recovery plan. The RIS is a short-term, flexible operational document focused on how, when, and by whom the recovery actions from the recovery plan will be implemented. This approach allows us to incorporate new information and adapt to changing circumstances with greater flexibility and efficiency. The RIS will be developed and maintained in cooperation with our conservation partners and will focus on the period of time and scope of activities that work best for our partners to achieve recovery goals.

EXECUTIVE SUMMARY

Species Status: The Umtanum Desert buckwheat (*Eriogonum codium*) is a rare, long-lived perennial plant endemic to the eastern end of Umtanum Ridge in the Hanford Reach National Monument (Hanford Reach NM) in Benton County, Washington. The species is restricted to a small area on a narrow discontinuous band of lithosol soils. On December 20, 2013, the U.S. Fish and Wildlife Service (Service) listed Umtanum desert buckwheat as a threatened species under the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq*; Act). In addition to lithosol soils, hot dry summers and cold winters in semi-arid shrub-steppe are the assumed primary habitat and environmental requirements for the species. The species has a recovery priority number of 5, indicating it is a species (versus a subspecies), faces a high degree of threat, and has a low potential for recovery (Service 2013a). In 2013, the Service designated critical habitat for the species (Service 2013b).

Recovery Vision: Recovery of Umtanum desert buckwheat will be signified by the presence of resilient and self-sustaining populations that conserve existing genetic diversity in the species' natural geographic range within protected sites. Populations will not be substantially threatened by wildfire, nonnative plant species, or other threats.

Recovery Strategy: The known historical range of Umtanum desert buckwheat is limited and the species currently only occurs on a naturally rare soil type. The main cause of the species' recent decline is the loss of individuals and degradation of its habitat by wildfires and invasive plant species; therefore, the recovery strategy emphasizes addressing these threats in the near-term. The recovery strategy seeks to improve: (1) resiliency by establishing populations of sufficient size and productivity to withstand stochastic events, (2) redundancy by establishing a sufficient number of populations to provide a safety margin to withstand catastrophic events, and (3) representation by expanding the ecological diversity and preserving the genetic diversity of the species.

We note that new or emerging threats may arise over time. If any such issues are so significant as to result in a need to change the recovery strategy or the statutorily required elements of the recovery plan under section 4(f)(1) of the Act, we will amend or revise the plan as appropriate.

Recovery Criteria: We expect Umtanum desert buckwheat to be recovered when the following criteria are met:

(1) At least six Umtanum desert buckwheat populations exist in suitable habitat that are managed to achieve the long-term conservation of the species. These populations can be comprised of newly discovered populations or those established through reintroductions.

(2) Each population will be self-sustaining with an average population size of at least 1,200 adult plants for a period of at least 15 years.

(3) Populations that contribute to Recovery Criterion 1 will be in a matrix of native

shrub-steppe habitat within the effective pollinator distance and threats are being managed by partners with long-term management commitments.

(4) Populations that contribute to Recovery Criterion 1 are adequately protected from wildfire. To minimize fuels that may increase wildfire frequency and severity, all populations will be located in shrub-steppe habitat with less than 15 percent total cover with less than 1 percent cover of nonnative or invasive plant species.

(5) Establish, store, and maintain seed collections at seed banks to support augmentation and reintroduction efforts in accordance with currently accepted standards (see CPC 2019) and to provide for ex-situ conservation in the event the species becomes extinct in the wild. A target of 3,000 viable seeds per subpopulation (9,000 total) from at least 50 maternal lines should be stored at a minimum of two Center for Plant Conservation-approved seed storage facilities. A permit under section 10(a)(1)(A) of the Act will be required for seed collection on Federal lands.

Recovery Actions and their Estimated Cost (in Fiscal Year 2022 dollars):

Recovery Actions	Estimated Costs
1. Protect the extant population and reduce wildfire risk. Implement habitat restoration activities to reduce the abundance of invasive plant species.	$229,000
2. Preserve and augment the extant population by connecting subpopulations and isolated individuals to increase reproductive rates.	$194,400
3. Identify potentially suitable habitat sites and survey for additional Umtanum desert buckwheat populations.	$50,800
4. In areas of suitable habitat, establish and/or identify at least five additional populations to increase the species' redundancy, representation, and resiliency.	$160,000
5. Monitor the rangewide population, track trends, and assess threats. Implement a rangewide monitoring protocol and determine population trend. Develop and implement a detailed monitoring plan.	$98,000
6. Study the species' ecology and breeding system, factors limiting reproductive success, the effect of climate change, and the response to management actions to guide conservation efforts.	$188,000
7. Promote awareness and conservation of Umtanum desert buckwheat throughout its geographic range.	$28,000
Total Estimated Cost	**$948,200**

Date of Recovery: Recovery criteria could be met by 2047, based on the conservative assumption that all recovery plan actions are fully funded and implemented as currently outlined, including cooperative efforts by all partners needed to achieve recovery.

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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 2018 updated National Marine Fisheries Service (NMFS) and U.S. Fish and Wildlife Service (Service) Interim Recovery Planning Guidelines, Version 1.4 (NMFS and Service 2018, entire).

Recovery plans are guidance documents developed to provide recommendations to reduce or alleviate threats to the listed species (includes distinct population segments, subspecies, species groups) and ensure self-sustaining populations in the wild. The Act (section 4(f)(1)) 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 document presents the Service's recovery plan for the conservation and recovery of Umtanum desert buckwheat (*Eriogonum codium*) which is a rare, long-lived perennial plant endemic to the eastern end of Umtanum Ridge in the Hanford Reach National Monument (Hanford Reach NM) in Benton County, Washington. On December 20, 2013, the U.S. Fish and Wildlife Service (Service) listed Umtanum desert buckwheat as a threatened species under the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq*; Act). The species has a recovery priority number of 5, indicating that it is a species (versus a subspecies), faces a high degree of threat, and has low potential for recovery (Service 2013a). In 2013, the Service designated critical habitat for the species (Service 2013b) (Figure 1).

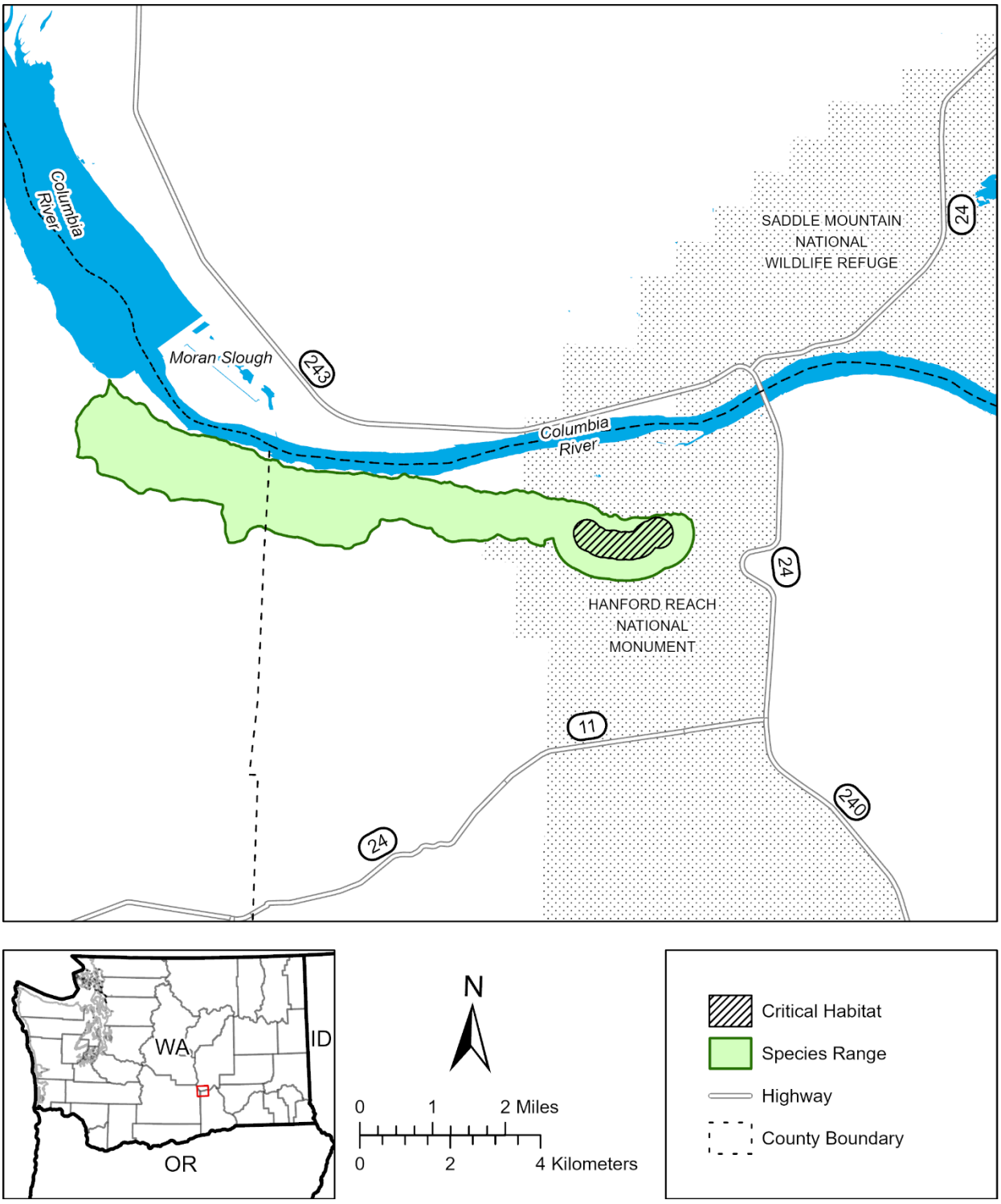

Figure 1. Location of Umtanum desert buckwheat and its designated critical habitat (Service 2013b).

The goal of this recovery plan is to provide guidance on how to manage or ameliorate threats to Umtanum desert buckwheat, such that it no longer requires protections afforded by the Act and therefore, warrants consideration for delisting. This recovery plan is based on the Species Biological Report (SBR) for Umtanum desert buckwheat (Service 2021a) that describes the life history and biology of the species, the current status of the species, and the threats that affect the species. The SBR is briefly summarized below. In cooperation with our partners, we also prepared a Recovery Implementation Strategy (RIS), which serves as an operational plan for stepping down the higher-level recovery actions into specific tasks (Service 2021b). The RIS is a separate document from this recovery plan, which can be modified as warranted, maximizing flexibility of recovery implementation. Both the SBR and RIS are available at https://ecos.fws.gov and will be updated as necessary.

BACKGROUND

Basic Species Information

For a more detailed literature review and full description of the biology, habitat, and distribution of Umtanum desert buckwheat, please refer to the final and revised listing rules (Service 2013a, 2013c) and the SBR (Service 2021a). The following is a brief overview of the natural history and conservation status of Umtanum desert buckwheat.

Umtanum desert buckwheat, also known as basalt desert buckwheat, is a narrow endemic, long-lived perennial; individuals have been estimated to be older than 100 years based on growth ring counts of stems from fire-killed plants (Dunwiddie et al. 2000, p. 62). The species is restricted to a small area of approximately 1.9 hectares (4.8 acres) on a narrow (25 to 150 meters [m] or 82 to 492 feet [ft]), discontinuous band on the eastern end of Umtanum Ridge in Hanford Reach National Monument (NM) (Reveal et al. 1995, p. 354; Dunwiddie et al. 2000, p. 59; Newsome pers. comm. 2021). The historical range of Umtanum desert buckwheat is unknown (Service 2013a, p. 23986). It is found exclusively on lithosol soils derived from the exposed Lolo Flow of the Priest Rapids Member of the Wanapum Basalt Formation. Umtanum desert buckwheat occurs at elevations between 329 m (1,080 ft) and 390 m (1,280 ft) on flat to gently sloping substrates that generally face north (Newsome and Goldie 2017, p. 1). In addition to lithosol soils, hot dry summers and cold winters in semi-arid shrub-steppe are the assumed primary habitat and environmental requirements for the species.

Only one population of Umtanum desert buckwheat is known despite survey efforts conducted between 1997 and the early 2000s on similar lithosol soils within the Lower Columbia River Basin. The single population is small and declining, and recruitment is extremely low. Even with high flower production, germination rates are low, seedling mortality is high, and growth between individuals and years is variable (Caplow et al. 2007, p. 1). In 1995, there was a wide range of sizes and age classes in the population (Reveal et al. 1995, p. 354). Unfortunately, fewer plants than expected were documented in the smallest size classes (plants less than 100 square

centimeters [cm] or 15.5 square inches [in]) compared to a typical size distribution, confirming that recruitment is insufficient to support a self-sustaining population (Dunwiddie et al. 2000, p. 62).

The population consists of three subpopulations, referred to as East, Middle and West. The population as a whole has ranged from a high of 5,228 plants in 1997 to a low of 2,515 plants in 2018 (Table 1). During 9 years of demographic monitoring from 1997 to 2006, only five seedlings in the East subpopulation survived beyond 1 year and only one seedling survived 5 years to produce flowers (Caplow et al. 2007, p. 3). Using a Population Viability Analysis (PVA) model, Caplow et al. (2007) reported an annual population growth rate of greater than 0.99 with minimal recruitment. The model did not account for stochastic events like wildfire and drought, and forecasted little or no risk of a 90 percent population decline within the next 100 years, a 13 percent chance of a decline of 50 percent over the next 50 years, and a 72 percent chance of a 50 percent decline within the next 100 years. The factors responsible for the population's annual decline of less than 1 percent from the PVA have not been fully studied or explained further.

Table 1. Census results of Umtanum desert buckwheat from 1995 to 2019. Subpopulation numbers shown by site name.

Year	East	Middle	West	Totals	Change (%)
1995	3,700	200	1,017	4,917 (6,352*)	-
1996**					
1997	4,400	163	665	5,228	6.32 (17.70*)
2005	3,367	168	873	4,408	-15.68
2011	4,061	168	940	5,169	17.26
2017**					
2018	1,869	100	555	2,515	-51.34
2019	2,239	120	657	3,016	19.49

*Census count is likely an underestimation due to uncounted plant clusters discovered in subsequent years. See description below for updated census estimate.
**Wildfire during these years; no census conducted.

Estimates for the population reflect the number of vegetative and flowering plants. When monitoring began, five subpopulations were delineated by breaks in substrate exposure (Dunwiddie et al. 2000, p. 60). Due to additional plants being discovered, the five subpopulations were redefined as three separate subpopulations: East, Middle, and West. Monitoring methods have been inconsistent over the years, and it is widely accepted that the monitoring efforts from 1995 to 2011 did not include all of the outlying plant clusters. In fact, the larger counts in 1997, 2011, and 2019 are attributed to either refined counting techniques or the discovery of previously unknown plants and clusters (Arnett pers. comm. 2011; Fertig pers.

comm. 2019). Therefore, the variation in numbers from counts conducted between 1995 and 2019 should not be interpreted as a precise record of change in population size, as not all outlying plant clusters were included (Arnett 2013, p. 3). Starting in 2019, monitoring has been systematic and included all known plant clusters.

As mentioned above, the population appeared to increase in 1997 (see Table 1) after the 1996 wildfire, but this was likely a result of refining survey methodology and discovering new plant clusters in 1997 that were not counted in 1995 (Dunwiddie et al. 2000, pp. 60-61). In 1995 and 1997, 4,917 and 5,228 live plants were counted, respectively. It is highly unlikely that the population recruited 311 adult plants in 2 years as it takes several years for Umtanum desert buckwheat to mature from a seedling into an adult plant. Using the more accurate 1997 census count, it is possible that the population in 1995 could have been 6,352 individuals (4,917 individuals counted in 1995 + 311 plants [1995 to 1997 difference] + 813 "dead" plants). In 1997, 813 plants were identified as "dead" and a minimum of 75 percent of these "dead" plants were attributed to the 1996 wildfire (Dunwiddie et al. 2000, p. 62). Based on this refined analysis, there was a 17.7 percent population decline between 1995 and 1996 which was most likely attributable to the 1996 wildfire. After the 2017 wildfire, the population declined 51.2 percent from 2011 to 2018 as a direct result of the wildfire (see Table 1). Notably, from 1997 to 2005, the population declined 15.7 percent in the absence of wildfire.

Threats

The most significant threats to Umtanum desert buckwheat are wildfires, invasive species, climate change, a narrow geographic distribution, a declining population, and low recruitment. Before the 1900s, wildfires were likely small, intense, and occurred at 32- to 70-year intervals (Service 2001, p. 23). However, in the last 20 years, more frequent and intense wildfires now threaten the species' existence by degrading suitable habitat and killing a significant portion of the population. Previous ground disturbance, wildfires, and lack of post-burn management have facilitated the establishment of fire-adapted and fire-promoting invasive species, such as cheatgrass (*Bromus tectorum*) and Russian thistle (*Salsola tragus*), in and adjacent to Umtanum Ridge (Newsome and Goldie 2017, p. 1). These invasive species act as a fuel source and compete with Umtanum desert buckwheat adults and seedlings for soil, nutrients, space, and moisture. Notably, cheatgrass and Russian thistle cluster around Umtanum desert buckwheat adults and seedlings (Dunwiddie et al. 2000, p. 68).

Climate change was identified as a threat at the time of listing. The term "climate" refers to the mean and variability of different types of weather conditions over time (IPCC 2014a, pp. 119-120). The term "climate change" thus refers to a change in the mean or variability of one or more measures of climate (e.g., temperature or precipitation) that persists for an extended period, typically decades or longer, whether the change is due to natural variability, human activity, or both.

Climate change may have direct and/or indirect effects on species. These effects may be positive, neutral, or negative, and they may change over time, depending on the species and other relevant considerations, such as interactions of climate with other variables (e.g., habitat fragmentation) (IPCC 2014b, pp. 283-290). Identifying likely effects often involves application of a Climate Change Vulnerability Index (CCVI). Vulnerability refers to the degree to which a species (or system) is susceptible to, and unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the type, scope, and rate of climate change and variation to which a species is exposed, its sensitivity, and its adaptive capacity (IPCC 2014a, p. 128; Glick et al. 2011, pp. 19-22).

Umtanum desert buckwheat was ranked "Moderately Vulnerable" to climate change using the CCVI (Fertig 2020, entire). By 2050, temperature severity is projected to increase 2.2 to 2.4 degrees Celsius (3.9 to 4.4 degrees Fahrenheit) (Figure 2) and moisture availability (measured as a ratio of actual to predicted evapotranspiration) is projected to decline 0.028 to 0.050 (Figure 3). Primary factors, beyond increasing temperature and decreasing moisture availability, responsible for the species' vulnerability to climate change include its distribution relative to anthropogenic barriers, dispersal and movements, and changes in historical hydrological niche. Umtanum desert buckwheat is restricted to the eastern end of Umtanum Ridge and is surrounded by human development including the Hanford Site, agricultural lands, and roads, all of which could restrict expansion or dispersal from the ridge. Umtanum desert buckwheat seeds are dispersed via gravity and wind, and potentially harvester ants; these mechanisms provide limited opportunities for seeds to disperse to other potentially suitable habitats. Over the past 50 years, Umtanum Ridge has experienced little variation in annual precipitation (less than 10.2 cm [4 in]), which greatly increases the species' vulnerability to climate change due to its hydrological niche (Young et al. 2016, p. 32). According to the CCVI report, leading threats to Umtanum desert buckwheat include drought, an increase in invasive plant species, and wildfire, and these threats will likely increase due to climate change.

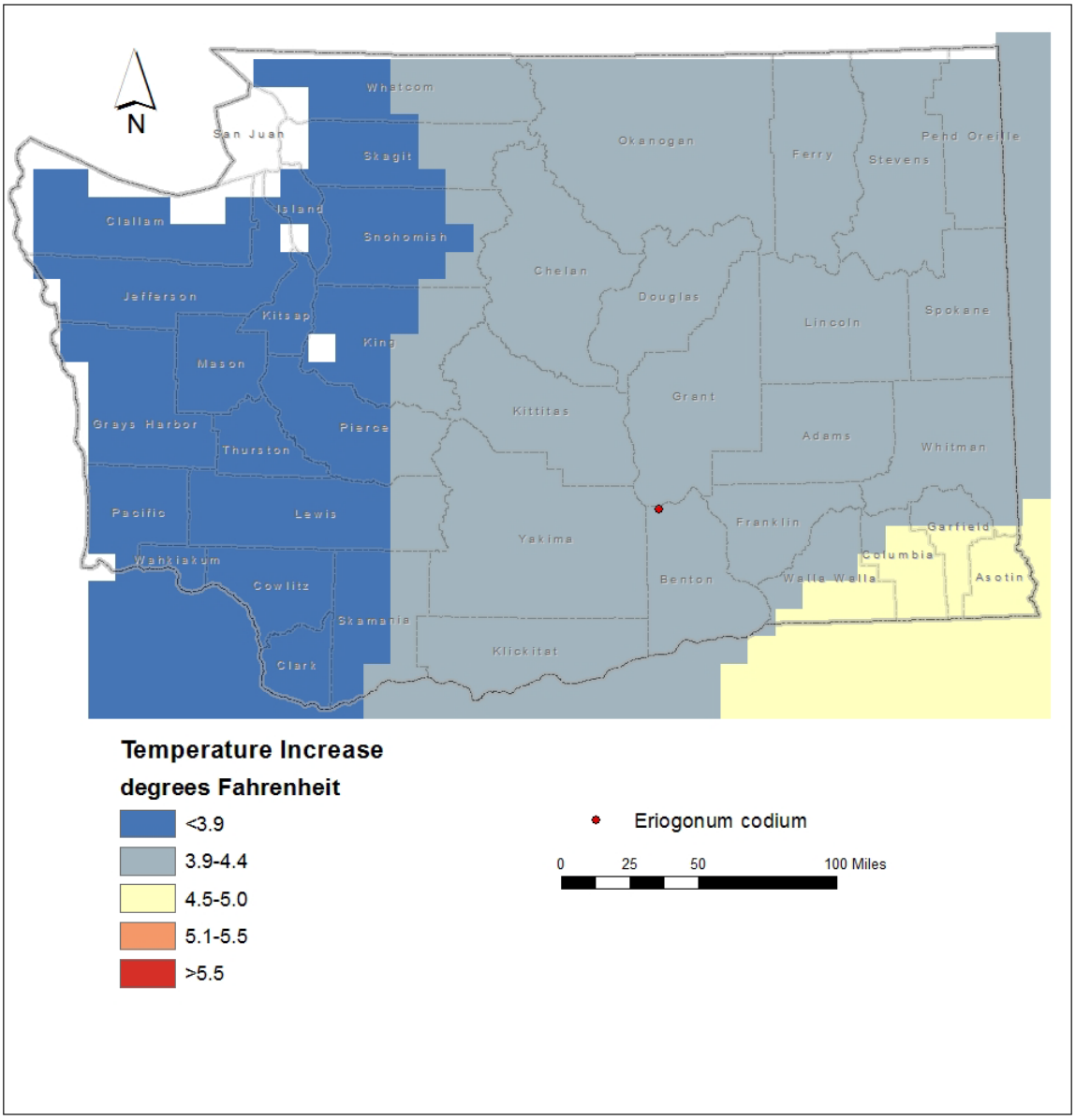

Figure 2. Exposure of Umtanum desert buckwheat occurrences in Washington to projected local temperature change by 2050 (Fertig 2020, p. 2). Base map layers from www.natureserve.org/ccvi.

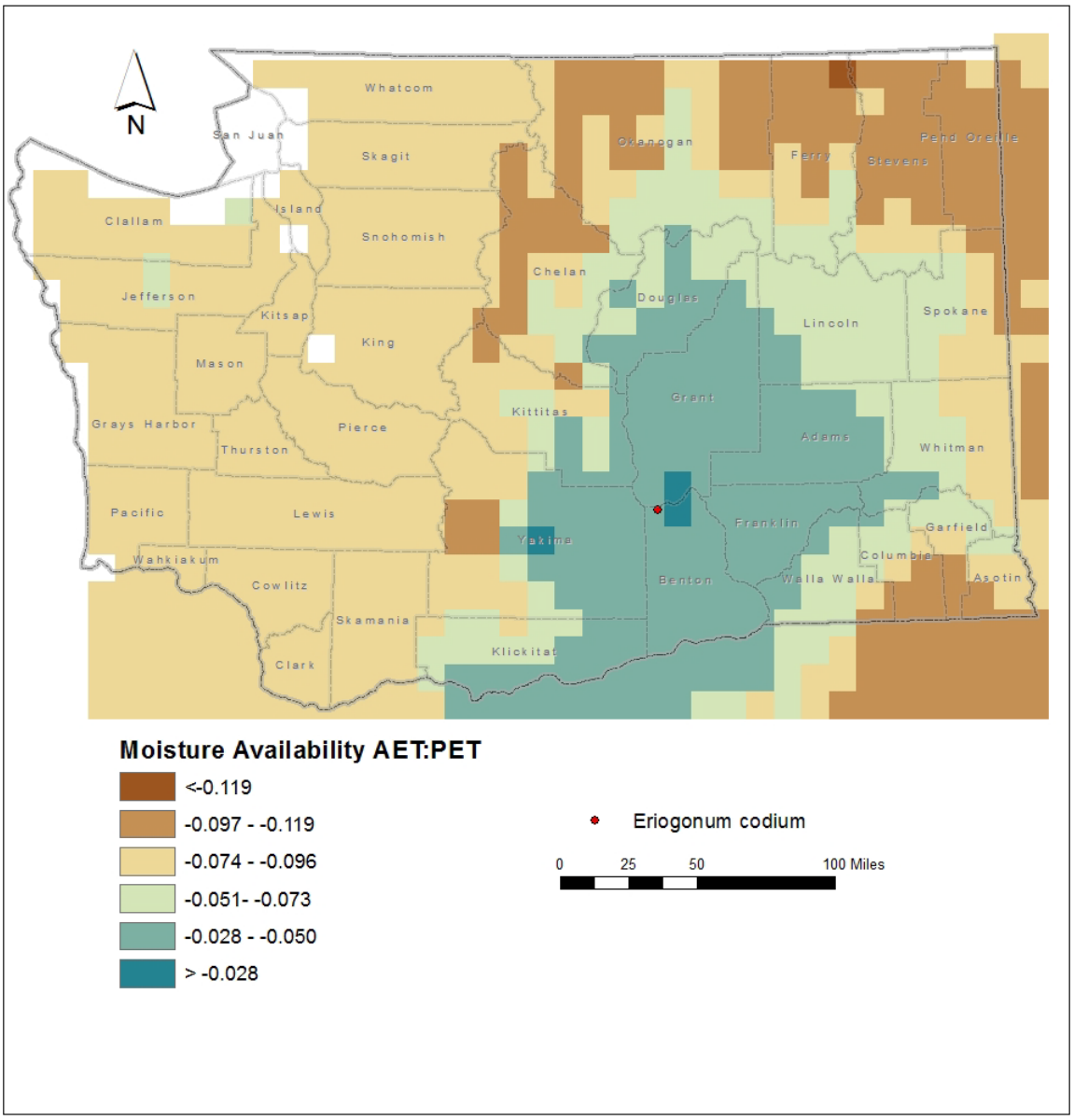

Figure 3. Exposure of Umtanum desert buckwheat occurrences in Washington to projected moisture availability (based on ratio of actual to predicted evapotranspiration) by 2050 (Fertig 2020, p. 3). Base map layers from www.natureserve.org/ccvi.

Umtanum Ridge receives annual precipitation of less than 15 cm (5.9 in) and snowfall (generally occurring from December through February) accounts for about 38 percent of all precipitation (Reveal et al. 1995, p. 354; Service 2008, pp. 3.8-3.10 as cited in Service 2013a). Umtanum desert buckwheat declined 15.7 percent from 1997 to 2005 and during that time, no wildfires occurred in the proximity of the population (see census year 2005 in Table 1).

Our assessment of species' viability, defined as the likelihood of persistence over the long term, is based on the concepts of resiliency, redundancy, and representation. The species has low resiliency, even though the single extant population is above the estimated minimum viable population (MVP) size, mainly due to the poor condition of its habitat and demographic factors such as invasive species abundance and low recruitment, respectively. There is only one population, so redundancy is non-existent. The species is a narrow endemic occupying a small area with little ecological differentiation and most likely has little genetic diversity resulting in low representation. In synthesis, the species' viability is low due to its low resiliency, redundancy, and representation and thus extinction risk remains high because of its inability to withstand stochastic and catastrophic events.

II. RECOVERY

RECOVERY VISION AND STRATEGY

A recovery vision is an explicit expression of recovery in terms of resiliency, redundancy, and representation. It builds on the viability for the species and defines what recovery will look like for the species. The recovery strategy provides a recommended approach for achieving the recovery vision, and ultimately, the delisting criteria.

Recovery Vision

Recovery of Umtanum desert buckwheat will be signified by the presence of resilient and self-sustaining populations that conserve existing genetic diversity in the species' natural geographic range within protected sites. Populations will not be substantially threatened by wildfire, nonnative plant species, or other threats.

Recovery Strategy

The known historical range of Umtanum desert buckwheat is limited and the species currently only occurs on a naturally rare soil type. The main cause of the species' recent decline is the loss of individuals and degradation of its habitat by wildfires and invasive plant species; therefore, the recovery strategy emphasizes addressing these threats in the near term. Climate change as well as the species' low recruitment, small population size, and its narrow geographic range, also threaten the species and actions to ameliorate these threats are included in the RIS.

The recovery strategy seeks to improve: (1) resiliency by establishing populations of sufficient size and productivity to withstand stochastic events, (2) redundancy by establishing a sufficient number of populations to provide a safety margin to withstand catastrophic events, and (3) representation by expanding the ecological diversity and preserving the genetic diversity of the species.

Resilient populations are large enough to withstand stochastic disturbance and have sufficient productivity to be self-sustaining. Viable populations must have sufficient numbers of individuals that are genetically diverse and dispersed in a way to allow for effective pollination and seed production.

The MVP for Umtanum desert buckwheat was informed by the species' life history traits and professional judgment of species experts following guidelines adapted from Pavlik (1996, p. 127-140). To conserve the genetic diversity and minimize inbreeding of Umtanum desert buckwheat, we estimate an MVP size of at least 1,200 mature, reproductive individuals per population (Service 2021, pp. 22-26). Species experts considered that a minimum of 1,200 plants per population is likely to maintain the species' resiliency and viability. In addition to an MVP size of at least 1,200 mature, reproductive individuals, the following criteria must be met for the

species to be considered recovered. The populations must show evidence of recruitment, maintain a 15-year average population size of at least 1,200 mature plants, and be self-sustaining (Service 2021a, p. 24).

We note that a population of Umtanum desert buckwheat with the number of individuals (1,200 individuals) is not immune from declining to low numbers or disappearing altogether. If stochastic events (e.g., wildfire) increase infrequency and intensity and there has been no reduction in invasive plant species, Umtanum desert buckwheat is less likely to persist into the future.

Redundancy of Umtanum desert buckwheat will be improved by conserving the single extant population on Umtanum Ridge and establishing at least five additional populations. Six populations are needed to improve redundancy to reduce extinction risk in case of devastating stochastic events like wildfire and drought, to maintain an acceptable minimum level of genetic diversity within the genus *Eriogonum* (Neel and Cummings 2003), and to meet the genetic-diversity conservation standard adopted in 1991 by the Center for Plant Conservation (CPC 1991). If additional populations are discovered, these populations would count toward the six total populations needed for recovery. At least 1.9 km (1.2 mi) or a physical barrier, such as the Columbia River, should separate these populations. As we move forward in recovery of Umtanum desert buckwheat and learn more about its genetic diversity, we will reassess this strategy.

The ecological and genetic representation of Umtanum desert buckwheat will be maintained through conservation of the extant population with at least 1,200 adult reproductive plants to prevent deleterious genetic conditions. Ecological and genetic representation might be improved through the restoration and enhancement of gene flow within the single population, by means of pollination or seed dispersal between and within the subpopulations. This may be accomplished through the augmentation of small subpopulations and linking isolated individuals. New populations will be established using genetic material from the Umtanum Ridge population, which will preserve the genetic diversity if this population is extirpated.

The timeframe required to improve the viability of Umtanum desert buckwheat is largely influenced by its life history. When all conservation actions have been accomplished, their effectiveness will be measured by an increase in the number of mature individuals produced via natural recruitment in each population to a viable level that is sustained without further human intervention (other than appropriate habitat management and monitoring). Because the species' generation time is 5 years, the criteria for delisting are framed in 5-year units.

We envision that when Umtanum desert buckwheat is recovered, there will be six viable and resilient populations able to withstand stochastic and catastrophic disturbances with sufficient ecological and genetic diversity and gene flow to maintain reproductive output and adapt to changing environmental conditions. To ensure sufficient resiliency, redundancy, and

representation, populations will be monitored and adaptively managed so that the species will no longer require the protections of the Act. Threats will be sufficiently understood and ameliorated to ensure long-term conservation. A monitoring and adaptive management approach will be implemented to address unforeseen events and threats. We expect that continued partnership with the Department of Energy (DOE), Yakama Nation, Confederated Tribes of the Umatilla Indian Reservation, Nez Perce Tribe, Washington Department of Natural Resources, University of Washington, and other interested parties will facilitate the implementation of the recovery actions outlined in this recovery plan to ameliorate the known threats (see pp. 9-11) and ultimately recover this species.

RECOVERY CRITERIA

Section 4(f)(1)(B)(ii) of the Act states that each recovery plan shall incorporate, to the maximum extent practicable, "objective, measurable criteria which, when met, would result in a determination... that the species be removed from the List." Legal challenges to recovery plans (i.e., Fund for Animals v. Babbitt, 903 F. Supp. 996 (D.D.C. 1995)) and a Government Accountability Office Audit (GAO 2006) also have affirmed the need to frame recovery criteria in terms of threats assessed under the five listing factors.

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 the species may be delisted. Delisting is the removal of a species from the Federal Lists of Endangered and Threatened Wildlife and Plants (Lists). Downlisting is the reclassification of a species from endangered to threatened. An "endangered species" is any species (species, subspecies, or distinct population segment) that is in danger of extinction throughout all or a significant portion of its range. A "threatened species" is any species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

Recovery criteria represent our best assessment, at the time the recovery plan is completed, of the conditions that would likely result in a determination that listing under the Act as threatened or endangered is no longer required. However, 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 because of threats to the species, based on an analysis of the five listing factors in section 4(a)(1). Section 4(b) require that the determination be made "solely on the basis of the best scientific and commercial data available." Thus, while recovery plans provide important guidance to the Service, States, and other partners on methods of minimizing threats to listed species and measurable criteria against which to measure progress towards recovery, they are guidance -- not regulatory -- documents.

Thus, a decision to delist or downlist a species is informed by the recovery criteria but is ultimately based on an analysis of threats using the best scientific and commercial data available.

When changing the status of a species, we first propose the action in the Federal Register to seek public comment and peer review, after which we announce a final decision in the Federal Register.

The species addressed in this recovery plan should be considered for delisting when the following objective and criteria have been met. These delisting criteria are subject to change as additional information becomes available about the species biology and threats.

Delisting (Recovery) Criteria

*Objectiv*e – Manage habitat and threats to enhance and establish resilient and self-sustaining populations that conserve existing genetic diversity in the species' natural geographic range. Populations will not be substantially threatened by wildfire, nonnative plant species, or other threats.

Delisting Criteria

We expect Umtanum desert buckwheat to be recovered and eligible for delisting consideration when the following criteria are met:

(1) At least six Umtanum desert buckwheat populations in suitable habitat that are managed to achieve the long-term conservation of the species. Populations should be separated by at least 1.9 km (1.2 mi) or a natural barrier such as the Columbia River. These populations can be comprised of newly discovered populations or those established through reintroductions. New populations discovered outside of the species' currently known range may contribute to meeting this criterion. Establishment of populations through reintroductions should use plant material representing the species' ecological and genetic diversity.

(2) Each Umtanum desert buckwheat population will be self-sustaining (e.g., finite rate of population increase, or lambda, greater than or equal to 1) with an average population size of at least 1,200 adult plants for a period of at least 15 years.

(3) Populations that contribute to Delisting Criterion 1 will be in a matrix of native shrub-steppe habitat within the effective pollinator distance of 300 m (980 ft) and threats are being managed by partners with long-term management commitments.

(4) Populations that contribute to Delisting Criterion 1 are adequately protected from wildfire. Management to achieve this may include, but is not limited to, establishment of effective firebreaks or maintenance of access routes sufficient to provide the safe transport of a variety of firefighting and management equipment. To minimize fuels that may increase wildfire frequency and severity, all populations will be located in shrub-

steppe habitat with less than 15 percent total cover as well as less than 1 percent cover of nonnative or invasive plant species.

(5) Establish, store, and maintain seed collections at seed banks to support augmentation and reintroduction efforts in accordance with currently accepted standards (see CPC 2019) and to provide for ex-situ conservation in the event the species becomes extinct in the wild. A target of 3,000 viable seeds per subpopulation (9,000 total) from at least 50 maternal lines should be stored at a minimum of 2 Center for Plant Conservation-approved seed storage facilities. This target should be achieved without collecting more than 10 percent of the seeds produced in 10 percent of collection years or between 2 to 5 percent annually in a multi-year collection effort. Seeds from maternal line collections should include at least 30 individuals up to a maximum of 50 individuals per collection year. To maximize the genetic representation from the source population, collections should be from individuals evenly distributed throughout the population using the protocols and schedules suggested by the facilities where the seeds will be stored. A permit under section 10(a)(1)(A) of the Act will be required for seed collection on Federal lands.

Delisting Criteria Rationale

To be considered for delisting, the Umtanum desert buckwheat should have at least six resilient populations distributed throughout its range to increase the species' chances of surviving catastrophic events. The more populations, and the wider their distribution, the more redundancy the species will exhibit. Six populations each separated by at least 1.9 km (1.2 mi) or a physical barrier, such as the Columbia River, is considered to provide sufficient redundancy while providing enough spatial separation in case of a catastrophic event such as an expansive wildfire. Six populations also corresponded to the number of populations within the genus *Eriogonum* that are needed to conserve the accepted minimum level of genetic diversity to meet the genetic-diversity conservation standard adopted in 1991 by the Center for Plant Conservation (Neel and Cummings 2003; CPC 1991).

The generation time of Umtanum desert buckwheat is estimated to be 5 years (Caplow et al. 2007, p. 3). Therefore, we identified a minimum population monitoring time frame of 15 years, or three generations, to track population size and assess whether a population is stable, declining, or increasing. A self-sustaining population trend over 15 years was determined to be reasonable considering the time required to delist similarly rare plants ranged from 10 to 60 years or two or more generations (e.g., Service 2015a [10 years], Service 2016a [20 years], Service 2015b and 2016b [25 years], and Service 2017 [60 years]).

We estimated an MVP size of at least 1,200 individuals per population to conserve the genetic and ecological diversity and minimize inbreeding in Umtanum desert buckwheat (adapted from Pavlik 1996, p. 137; see Tables 2 and 3). A minimum population size of 1,200 plants is a reasonable number of plants per population to maintain the species' resiliency, representation, and viability. In addition to the MVP, each population should show evidence of reproduction and recruitment to ensure the population is self-sustaining and can persist with minimal management.

The current evidence indicates Umtanum desert buckwheat is an outcrossing species that relies on multiple pollinators for effective reproduction, thus the long-term viability of the species depends on the presence of pollinator species. Based on the foraging distance of three genera of solitary bees that occur in the Hanford Reach (Service 2013b, p. 24107), we determined the effective pollinator distance of 300 m (980 ft).

Wildfire is a key reason for the species' decline, thus protecting the Umtanum desert buckwheat population from wildfire will mitigate a major threat. The extant Umtanum Ridge population occurs in a shrub-steppe habitat with reduced native vegetative cover (less than 25 percent) compared to other shrub-steppe sites (Rush and Gamon 1999, p. 8). Establishment of effective firebreaks and providing access for firefighting equipment will substantially reduce the risk of wildfire and allow for rapid wildfire suppression efforts. Additionally, we estimated that shrub-steppe containing 10 to 15 percent total cover of native plant species and less than 1 percent cover of nonnative or invasive plant species is essential to the Umtanum desert buckwheat population resiliency against stochastic and catastrophic wildfire events as well as competition (Service 2013b, p. 24018). Research has demonstrated that both low (1 to 5 percent) and high (greater than 15 percent) cheatgrass cover can result in similar increased wildfire risk (Bradley et al. 2017, p. 1493). In addition to being fire-intolerant, the species has been described as having a low competitive ability and is confined to an area of low vegetative cover a few meters from a sparsely populated cliff slope (Service 2013 b, p. 24017).

Seed banks are vitally important in the event of extinction and for use in augmentation and reintroduction efforts. Collecting and cataloging seeds by maternal lines ensures equal genetic representation from the entire population in augmentation and reintroduction efforts, thereby maintaining the genetic diversity. In accordance with currently accepted standards (see CPC 2019), we set conservative seed collection targets to protect against over-collection while maximizing the seeds collected in a given year. Storing seed collections at a minimum of two Center for Plant Conservation-approved storage facilities protects against unforeseen events that might otherwise result in the complete loss of all seed collections if only stored at one facility.

III. RECOVERY ACTIONS

This recovery plan identifies recovery actions needed to implement the recovery strategy and attain the recovery criteria for the Umtanum desert buckwheat. Implementation of any recovery action will depend on its priority, availability of funds and resources, coordination with partners, and complexity and logistical constraints. A broad action may have multiple components developed as needed to best coordinate recovery implementation. Specific project-level implementation of these actions will be accomplished through shorter-term activities (collectively referred to as the Recovery Implementation Strategy [RIS] which can be found on the Service's website here) in coordination with all partners interested and willing to work on implementing the activities. Activities are intended to be adaptable and guide all partners to coordinate recovery implementation and further identify those responsible for each action described in the recovery plan. Because these activities will be described in the RIS, they can be modified as needed without requiring future revision of this recovery plan, so long as they remain consistent with the recovery actions described here.

As discussed in the Introduction, this recovery plan is a guidance document, not a regulatory document. As such, implementation of recovery actions is voluntary and depends on the cooperation and commitment of numerous partners in this conservation effort. All Federal agencies have an obligation under section 7(a)(1) of the Act to carry out programs for conservation of federally listed species.

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 Umtanum desert buckwheat. Priority 1 actions are those actions that must be implemented 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 to mitigate a significant threat. Priority 3 actions are all other actions necessary to provide for the species' full recovery. The assignment of priorities does not imply that some recovery actions are of low importance, but instead suggests that lower-priority items may be deferred while higher-priority actions are implemented. Tab associates the recovery actions to the threats they address. Specific tasks required to implement these recovery actions are detailed in the RIS (Service 2021b).

Priority 1

1. Protect the extant population and reduce the risk from wildfire. Improve access to Umtanum Ridge for emergency activities and recovery actions. Implement habitat restoration activities within and adjacent to occupied habitat to reduce wildfire risk due to abundant invasive plants.

2. Preserve and augment the extant population by connecting subpopulations and isolated individuals to increase reproductive rates.

3. Identify potentially suitable habitat sites and survey for additional Umtanum desert buckwheat populations.

4. In areas of suitable habitat, establish and/or identify at least five additional populations to increase the species' redundancy, representation, and resiliency.

Priority 2

5. Monitor the rangewide population, track trends, and assess threats. Implement a rangewide monitoring protocol and determine population trends. Develop and implement a detailed monitoring plan to assess known threats and identify potential new threats to the species and its habitat.

6. Study the species' ecology and breeding system, factors limiting reproductive success, the effect of climate change, and the response to management actions to guide conservation efforts.

Priority 3

7. Promote awareness and conservation of Umtanum desert buckwheat throughout its geographic range.

Table 2. Factors affecting the survival of Umtanum desert buckwheat (Service 2013a) and associated recovery actions and criteria.

Act Listing Factors	Threats Description	Delisting (Recovery) Criteria	Recovery Actions
Factor A: The present or threatened destruction, modification, or curtailment of its habitat or range	Severe wildfires, invasive plant species	1, 3, 4, 5	1, 3, 4, 5, 6
Factor B: Overutilization for commercial, recreational, scientific, or educational purposes	Trampling, seed collections	1, 2, 5	5, 6, 7
Factor E: Other natural or manmade factors affecting its continued existence	Stochastic events	1, 2, 3, 4	1, 2, 3, 4, 5, 6, 7
	Small population size	1, 2, 4, 5	1, 2, 3, 4, 5, 6
	Small geographic distribution	1, 4	1, 2, 3, 4, 5, 6, 7
	Low recruitment	1, 2, 3, 4, 5	1, 2, 4, 5, 6
	Climate change	1, 2, 3, 4, 5	1, 2, 3, 4, 5, 6, 7

IV. ESTIMATED TIME AND COST OF RECOVERY

The estimated cost of completing the recovery actions identified as necessary to achieve the recovery criteria for Umtanum desert buckwheat is $948,200 (see Table 3). We estimate that it will take at least 10 years to identify suitable habitat and establish or locate five additional populations. Therefore, it will take, at a minimum, 15 years for all populations to show evidence of adequate stability or growth. In total, we estimate that completion of these actions could be accomplished by 2047, assuming effective coordination and cooperation among necessary partners and stakeholders.

Table 3. Recovery actions and estimated costs.

Recovery Action	Estimated Cost
1. Protect the extant population and reduce wildfire risk. Improve access to Umtanum Ridge for emergency activities and recovery actions. Implement habitat restoration activities within and adjacent to occupied habitat to reduce the abundance of invasive plant species.	$229,000
2. Preserve and augment the extant population by connecting subpopulations and isolated individuals to increase reproductive rates.	$194,400
3. Identify potentially suitable habitat sites and survey for additional Umtanum desert buckwheat populations.	$50,800
4. In areas of suitable habitat, establish and/or identify at least five additional populations to increase the species' redundancy, representation, and resiliency.	$160,000
5. Monitor the rangewide population, track trends, and assess threats. Implement a rangewide monitoring protocol and determine population trend. Develop and implement a detailed monitoring plan to assess known threats and identify potential new threats to the species and its habitat.	$98,000
6. Study the species' ecology and breeding system, factors limiting reproductive success, the effect of climate change, and the response to management actions to guide conservation efforts	$188,000
7. Promote awareness and conservation of Umtanum desert buckwheat throughout its natural geographic range.	$28,000
Total Estimated Cost	**$948,200**

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VI. APPENDIX A

GLOSSARY

Term	Definition
Augmentation	Adding seeds or individual plants to a population with the aim of increasing population size or genetic diversity and thereby improving viability (CPC 2019).
Demography	Scientific study of populations (e.g., reproductive and survival rates, dispersal).
Endemic	An organism restricted to a specific habitat or geographic range.
Genetic diversity	The amount of variation found in a species.
Habitat	Ecological or environmental area that is inhabited by a particular species of animal, plant or other type of organism.
Invasive species	Species that is nonnative (or alien) to the ecosystem under consideration and whose introduction causes or is likely to cause economic or environmental harm or harm to human health (Clinton 1999).
Lithosol soils	Any of a group of shallow azonal soils consisting of imperfectly weathered rock fragments.
Minimum viable population	The fewest individuals required for a specified probability of survival over a specified period of time (Pavlik 1996; Mace and Lande 1991).
Perennial	A plant that lives for more than one full year.
Population Viability Analysis (PVA) model	A model that estimates the probability that a population, or set of populations, will persist for a specific time in a particular environment (Beissinger and McCullough 2002, pp. 6-7).
Ramet	A physiologically distinct organism that is part of a group of genetically identical individuals derived from one progenitor.
Recruitment	Addition of new individuals to a population.
Redundancy	The ability of a species to with stand catastrophic events by spreading risk among multiple populations or across a large area (Smith et al. 2018, p. 304).

Term	Definition
Representation	The ability of a species to adapt to changing environmental conditions over time as characterized by the breadth of genetic and environmental diversity within and among populations (Smith et al. 2018, p. 304).
Resiliency	The ability of a species to withstand stochastic disturbance; resiliency is positively related to population size and growth rate and may be influenced by connectivity among populations (Smith et al. 2018, p. 304).
Ruderal	Early stage of succession (colonization).
Seral	An intermediate developmental stage in ecological succession (Wikipedia 2017).
Self-sustaining population	A population that is able to persist without human intervention.
Species viability	A species' ability to sustain populations in the wild beyond the end of a specified time period, assessed in terms of its resilience, redundancy, and representation (Service 2015).
Stochastic	Unpredictable or random event (CPC 2019).
Taxon	(Plural, taxa). A natural group of organisms at any rank in the taxonomic hierarchy (Anderson 2001).

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VII. APPENDIX B

SUMMARY OF COMMENTS RECEIVED ON THE DRAFT RECOVERY PLAN FOR UMTANUM DESERT BUCKWHEAT

We published a notice of availability in the Federal Register on September 1, 2021 (86 FR 49045), to announce the availability of the Draft Recovery Plan for Umtanum Desert Buckwheat for public review and comment. We posted an electronic version of the draft recovery plan on the Service's Species Profile webpage (https://ecos.fws.gov/ecp/species/3627).

We also developed and implemented a communications plan that included: (1) publishing an announcement on our webpage (https://www.fws.gov/wafwo/index.cfm); (2) sending notifications to Congressional contacts in appropriate Districts; (3) sending email notifications to key stakeholders and interested parties; (4) issuing a news release; and (5) placing a social media post on our Facebook account. These outreach efforts were conducted in advance of and shortly after the Federal Register publication to ensure that we provided adequate notification to all potentially interested audiences of the 60-day opportunity to review and comment on the draft recovery plan.

After the public comment period, we received three comments from a researcher.

We considered all substantive comments, and to the extent appropriate, we incorporated the applicable information or suggested changes into the final recovery plan. Below, we provide a summary of specific comments received from peer and partner reviewers with our responses. We appreciate the input from all commenters. We also provided copies of all comments received during the formal public comment period to all relevant Federal agencies for their consideration prior to implementation of the final recovery plan in accordance with section 4(f)(5) of the Act.

Recommendation to reconsider and potentially expand the timeframe proposed for evaluating the self-sustaining criteria.

A 15-year timeframe for determining whether a population was self-sustaining was chosen based on the best scientific information available. As we currently understand, 15 years encompasses three generations for this species. Three generations was deemed sufficient to determine the growth rate for this long-lived species. Over this timeframe, we would be able to assess whether the population was declining, increasing, or stable, and ultimately, whether it was self-sufficient, which is our main objective.

Recommendation to increase seed collection to 3,000 seeds from at least 50 maternal lines from all known subpopulations as a base reserve and then make additional collections to provide source material for use in recovery actions.

We agree that increasing the number of seeds collected per subpopulation would be beneficial to for adequate seed banking while also ensuring genetic and ecological representation in future recovery actions. We have edited the criteria to reflect this recommendation.

Recommendation to increase the estimated cost to recovery based on potential need for multiple outplantings before population establishment.

We agree that the recovery costs may be more than what is estimated depending on multiple factors in the future. However, we made the time and cost estimate based on the conservative assumption that all recovery plan actions are fully funded and implemented successfully as currently outlined, including cooperative efforts by all partners needed to achieve recovery.