CLAY-LOVING WILD BUCKWHEAT

(*ERIOGONUM PELINOPHILUM*)

Five-year Status Review:
Summary and Evaluation

Photo Credit: Alicia Langton

U.S. Fish and Wildlife Service
Mountain Prairie Region
Lakewood, Colorado

August 2022

U.S. FISH AND WILDLIFE SERVICE
FIVE-YEAR STATUS REVIEW
for
CLAY-LOVING WILD BUCKWHEAT
(*Eriogonum pelinophilum*)

Species Reviewed: Clay-loving wild buckwheat (*Eriogonum pelinophilum*)

Federal Register Notice of Listing Determination:

- July 13, 1984. Final Rule to Determine *Eriogonum pelinophilum* to be an Endangered Species and to Designate Critical Habitat. (49 FR 28562).

Federal Register Notice Announcing Initiation of this Review:

- April 12, 2019. Initiation of 5-Year Status Review of Six Species in the Mountain-Prairie Region; request for information (84 FR 14965).

Lead Region: Mountain-Prairie Region, Region 6, Western Colorado Ecological Services Field Office, Ann Timberman, Western Colorado Field Supervisor, ann_timberman@fws.gov.

Classification: Endangered

Methodology used to complete this review: In accordance with section 4(c)(2) of the Endangered Species Act of 1973 (16 U.S.C Section 1531 *et seq.*), as amended (Act), the purpose of a five-year status review is to assess each threatened and endangered species to determine whether its status has changed and it should be classified differently or removed from the Lists of Threatened and Endangered Wildlife and Plants. Status reviews are to be completed in accordance with Sections 4(a) and 4(b) of the Act (16 U.S.C. Section 1533(c)). We solicited data for this five-year status review and the associated Species Status Assessment (SSA), from interested parties through an April 12, 2019, *Federal Register* notice announcing this review (84 FR 14965) and through a data call during the SSA process. We reviewed all information that we received and incorporated information relevant to our analysis in our SSA (Service 2022, entire). Relevant information that we received from these data calls included: summaries of conservation actions, monitoring information, reports on species genetics, and information on threats to the species from the Bureau of Land Management, Colorado Parks and Wildlife's Colorado Natural Areas Program, the Colorado Natural Heritage Program, and the University of Northern Colorado.

REVIEW ANALYSIS

Overview of the Species Status Assessment Process

The SSA provides the U.S. Fish and Wildlife Service's (Service's) comprehensive biological status review for clay-loving wild buckwheat, including a thorough account of the species' current and future viability—the ability of a species to sustain populations in the wild over time (Service 2016, p. 21; Service 2022, entire). Scientific experts contributed to our analysis, and the draft SSA was independently peer reviewed and reviewed by partners, including peers and partners from State wildlife agencies, Federal agencies, academia, and non-governmental organizations. We incorporated the results of the peer and partner review into the SSA. The SSA is available online on the Service's clay-loving wild buckwheat webpage at *https://ecos.fws.gov/ecp/species/3348*.

The SSA provides the best available biological information to inform our recommendation on the status of clay-loving wild buckwheat in this five-year status review. This includes descriptions of the species' resource needs and analyses of current and future conditions to assess the viability of the species, which we describe in terms of the conservation biology principles of resiliency, redundancy, and representation (Shaffer and Stein 2000, pp. 307–310; Wolf et al. 2015, entire; Smith et al. 2018, entire).

We define resiliency, redundancy, and representation—collectively known as the 3Rs—as,

- **Resiliency** is the ability of a population to persist in the face of stochastic events, or for populations to recover from years with low reproduction or reduced survival. Resiliency is associated with population size, growth rate, and the quality and quantity of habitat.
- **Redundancy** is the ability of a species to withstand catastrophic events, for which adaptation is unlikely. Redundancy is associated with the number and distribution of populations.
- **Representation** is the ability of a species to adapt to changes in the environment. Representation is associated with species' ecological, genetic, behavioral, or morphological diversity.

For this SSA, we defined viability as the ability of clay-loving wild buckwheat to sustain analytical units[1] in the wild over a biologically meaningful timeframe, which we defined as mid-

[1] Occurrences of clay-loving wild buckwheat do not fit neatly into traditional populations (i.e., the entire range shares some connectivity). However, given the fine-scale genetic structure described in Naibauer and McGlaughlin (2022, entire), we have grouped occurrences of clay-loving wild buckwheat into three analytical units—Delta, Selig, and Fairview. These analytical units highlight what limited genetic diversity clay-loving wild buckwheat does exhibit, and the units also align well with natural geological and ecological features (e.g., differences in topography and precipitation) and management boundaries. We felt delineating clay-loving wild buckwheat into these three analytical units would allow us to discern the nuances in conditions that occur across the range of the species and to discern the stressors that are influencing those conditions. Boundaries for these analytical units include all known plant occurrences and suitable habitat.

century (i.e., 2055). While we do not know the exact lifespan of clay-loving wild buckwheat, we know that the species is long-lived (i.e., >20 years). Mid-century is a timeframe over which we can reasonably project conservation efforts and stressors and over which we can begin detecting the impacts stressors or conservation measures might have on the species.

For our analysis, we identified clay-loving wild buckwheat's ecological requirements for survival and reproduction at the individual, population, and species levels, and we described the factors, both positive and negative, that influence the viability of clay-loving wild buckwheat currently and into the future. We then evaluated clay-loving wild buckwheat's current levels of resiliency, redundancy, and representation, and we projected plausible changes to these 3Rs into the future; considered together, the current and future levels of resiliency, redundancy, and representation characterize the viability of clay-loving wild buckwheat (Service 2022, entire). The SSA therefore provides the scientific analysis for the five-year status review.

Summary of Species Status Assessment for Clay-loving Wild Buckwheat

In this five-year review, we provide a summary of the SSA for clay-loving wild buckwheat; for more information, see the full SSA (Service 2022, entire).

Summary of Life History and Distribution from the SSA

Clay-loving wild buckwheat is a low-growing, rounded, densely branched sub-shrub in the buckwheat family (Polygonaceae). The species grows in clay barrens derived from the Mancos Shale Formation in the rolling clay hills and flats immediately adjacent to the communities of Delta and Montrose, Colorado (Figure 1). Clay-loving wild buckwheat is a long-lived perennial (i.e., > 20 years), and plants generally grow up to about four inches high (10 centimeters [cm]) and seven inches across (20 cm). Clay-loving wild buckwheat has dark green leaves that roll inward and small white to cream colored flowers.

Flowering typically occurs from late May to early September, and individual flowers usually last fewer than three days. However, individual plants can flower for three to six weeks. Clay-loving wild buckwheat requires a pollinator and has a mixed breeding system with some pollination occurring between flowers on the same plant and some pollination occurring between flowers from different plants (Bowlin et al. 1993, p. 300). Fruiting occurs from June through September.

When clay-loving wild buckwheat was first listed, the species was known from only one site with roughly 10,000 individuals at the northern end of the species' currently known range (49 FR 28562; Figure 1). Since the species' listing, increases in survey effort have discovered more occurrences of the plant. Clay-loving wild buckwheat is now known to exist across 15 occurrences (Figure 2) and potentially exists at six additional historical occurrences. Despite the discovery of new occurrences, annual monitoring efforts by the Bureau of Land Management (BLM) have documented declines in plant density across the species' range (BLM 2021, entire), particularly over the last five years. Some occurrences experienced declines greater than 70 percent when compared to estimated densities from 2013 (BLM 2021, p. 5).

Figure 1. Current range of clay-loving wild buckwheat (*E. pelinophilum*) in Delta and Montrose Counties, Colorado. Red shading shows the species' designated critical habitat and the species' range as it was known at the time of the listing in 1984.

For the purposes of the SSA, we grouped occurrences of clay-loving wild buckwheat into three analytical units—Delta, Selig, and Fairview (Service 2022, pp. 20-21; Figure 3). These analytical units highlight what limited genetic diversity clay-loving wild buckwheat does exhibit, and the units align well with natural geological and ecological features (e.g., differences in topography and precipitation) and management boundaries. Each analytical unit contains one or more BLM monitoring sites (Figure 3). For the SSA, we evaluated resiliency within each analytical unit and redundancy and

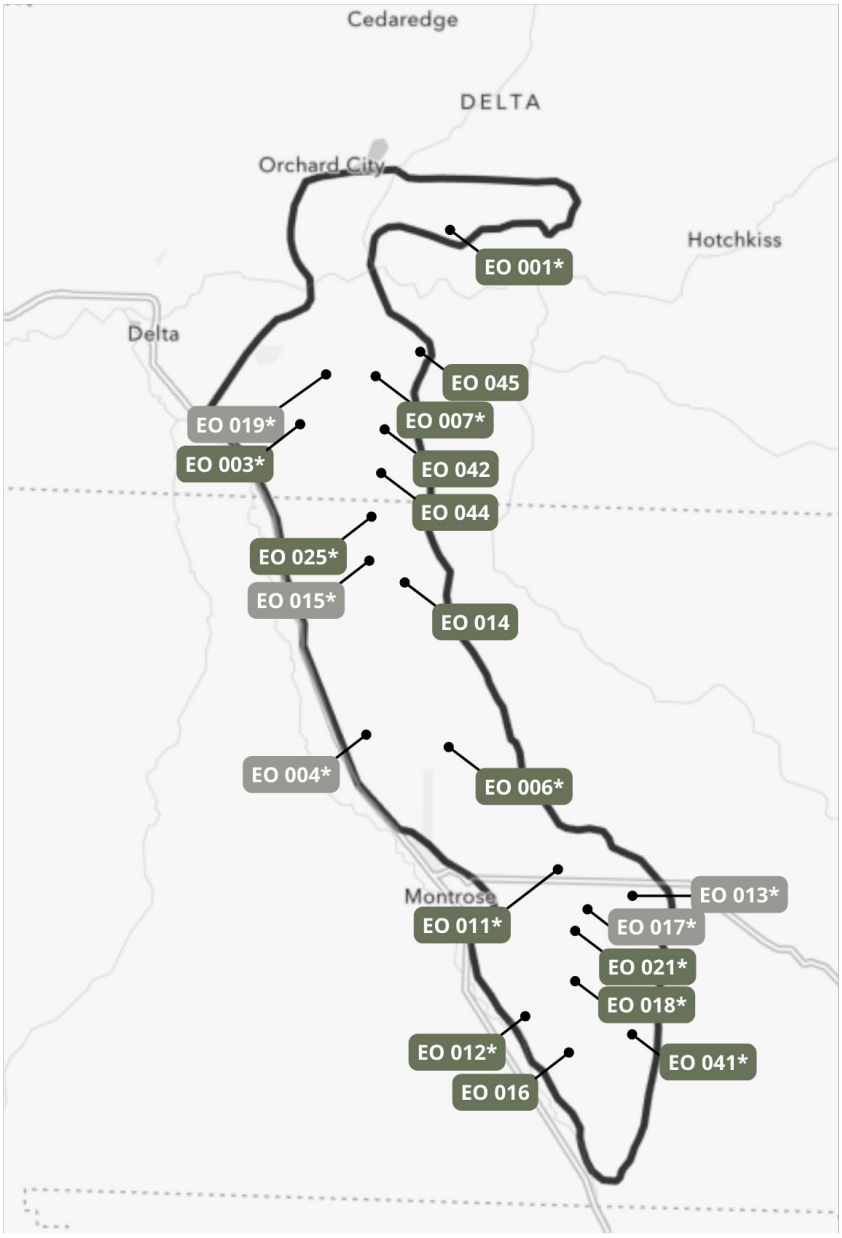

Figure 2. Distribution of occurrences of clay-loving wild buckwheat. There are a total of 15 active occurrences. Locations identified in this map are not precise, but are meant to give the reader a general understanding of the distribution of clay-loving wild buckwheat across the landscape. * indicates the occurrence occurs at least partially on private land.

representation at the species level. The SSA provides additional detail regarding these analytical units (Service 2022, pp. 20-21).

Summary of Needs from the SSA

Individuals of clay-loving wild buckwheat need clay substrate derived from the Mancos Shale Formation with adequate soil moisture and cool enough soil temperatures to facilitate water uptake. The specific quality and quantity of these resources influence the ability of individual plants to reproduce, grow, and survive at different life stages (Service 2022, pp. 22-27). These resources support resilient analytical units, which are characterized by abundance, recruitment, and survivorship across age classes which maintain or expand the analytical unit, abundant pollinators, and strong genetic connectivity within the analytical unit and with other analytical units. These factors impact an analytical unit's ability to withstand environmental stochasticity (resiliency). Clay-loving wild buckwheat as a species needs multiple diverse, resilient analytical units distributed across the

species' range to reduce impacts of catastrophic events (redundancy) and to adapt to long-term environmental change (representation).

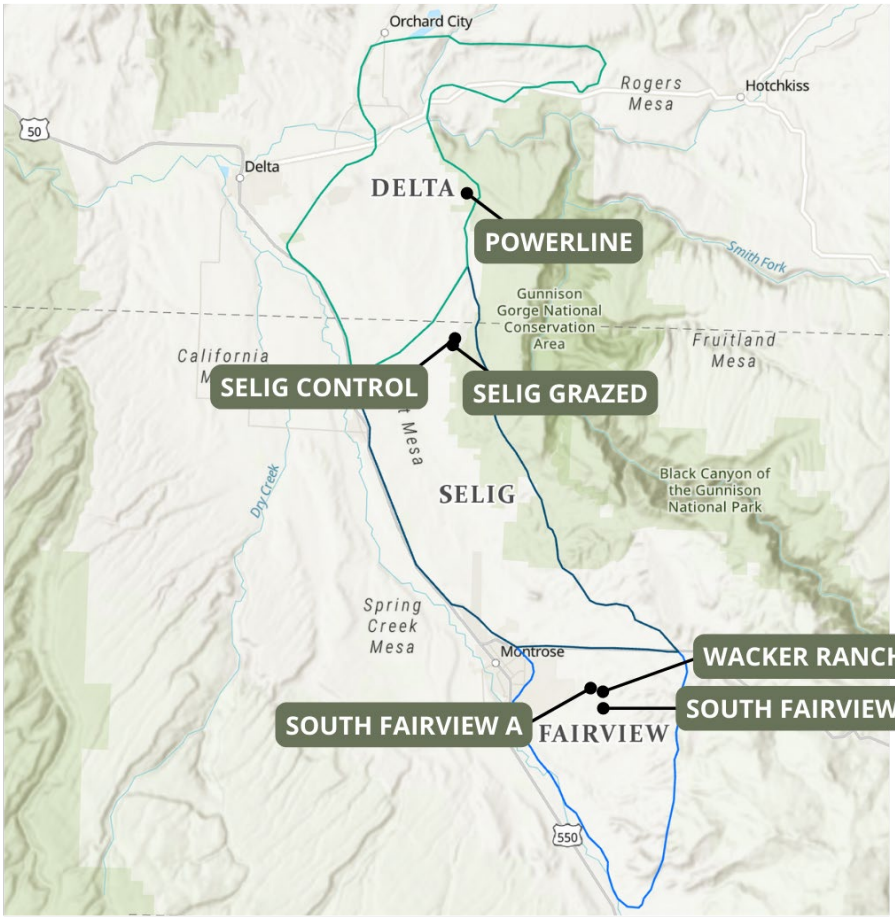

Figure 3. Clay-loving wild buckwheat analytical units used to analyze resiliency, redundancy, and representation. Callouts show BLM monitoring sites in each analytical unit.

Summary of Stressors and Conservation Efforts from the SSA

A wide variety of stressors may influence resiliency, either by directly affecting individuals or by reducing the quality and quantity of habitats. Stressors that could influence the viability of clay-loving wild buckwheat include incompatible livestock grazing, presence of invasive species, off-highway vehicle (OHV) use, commercial and residential development, irrigation operations, development and maintenance of utility corridors, and climate change. These stressors are interrelated to varying degrees (Figure 4); for example, increases in OHV use may increase the introduction and presence of invasive species in clay-loving wild buckwheat habitat.

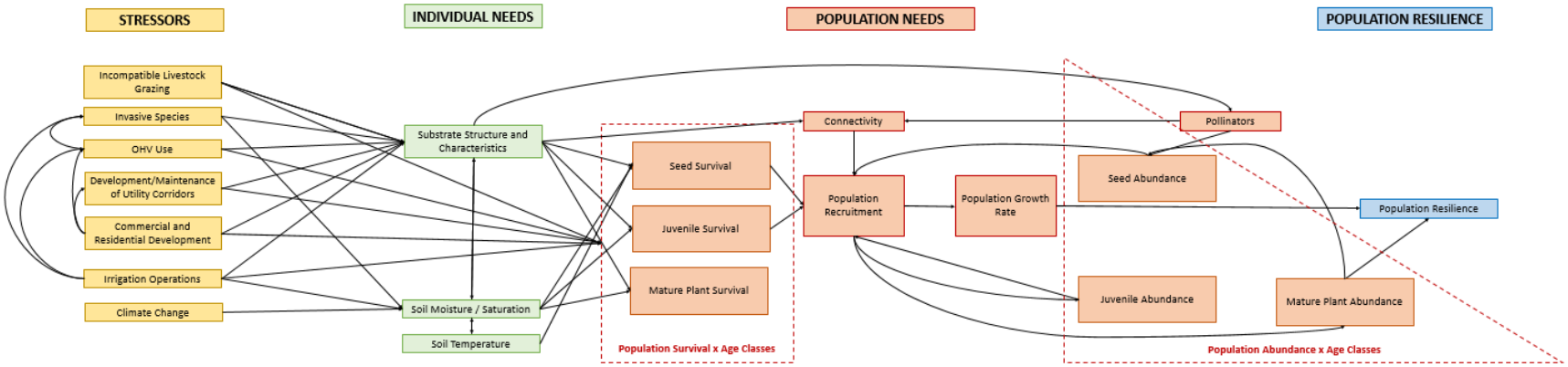

Figure 4. Conceptual model of interrelated stressors which influence needs at the individual and analytical unit levels and impact analytical unit resiliency.

Many of these stressors occur throughout the species' range on both public and private lands. Most public lands have management in place to protect the species (e.g., special land designations, fencing, and no surface occupancy stipulations). Private lands, however, have few known protections in place, though there are exceptions (e.g., fencing exclosures and monitoring at Montrose Model Airplane Club). In total, about 45 percent of the species' range is located on public land (Service 2022, p. 33). However, the exact amount of public and private land and associated protections varies among the three analytical units.

There are a variety of conservation efforts that either reduce or ameliorate stressors or improve habitat condition for clay-loving wild buckwheat. These conservation efforts include special land designations, fencing and exclosures, no surface occupancy stipulations, and several ongoing monitoring efforts. Most of these conservation efforts are implemented by the BLM, the Colorado Natural Areas Program, and the Colorado Natural Heritage Program.

Positive actions, in the form of conservation efforts, such as land protections and regulations, have reduced sources of habitat degradation. These efforts have maintained some resiliency in the three analytical units and will be important to the viability of clay-loving wild buckwheat now and in the future. The SSA provides our full analysis of stressors and conservation efforts (Service 2022, pp. 28-35).

Summary of Current Condition from the SSA

In the SSA, we evaluate current condition by examining current levels of resiliency in the three analytical units and their contributions to species' redundancy and representation. Below, we summarize our evaluation of current condition for each of the 3Rs. Additional detail regarding our analysis is provided in the SSA (Service 2022, pp. 44-48).

Summary of Current Resiliency

We describe the resiliency for each of the three analytical units in terms of the current condition of the habitat and demographic factors needed by clay-loving wild buckwheat (Service 2022, pp. 44-48). We developed a categorical model (i.e., high, moderate, low) to calibrate resiliency based on a range of conditions for three habitat factors (substrate structure and characteristics, soil moisture, and soil temperature) and three demographic factors (abundance distributed across age classes, analytical unit growth rate and recruitment, and genetic connectivity).

We selected these habitat and demographic factors based on their importance to resiliency and because we could evaluate them consistently across all three analytical units. More information on exactly how each metric was developed is available in the SSA (Service 2022, pp. 36-43).

We then used this categorical model as a key to evaluate resiliency for each analytical unit by systematically evaluating the current condition of each habitat and demographic factor (Table 1). To calculate an overall score for resiliency, we assigned equal values to the resiliency categories and then calculated the total score of the habitat and demographic factor rankings (Service 2022, pp. 36-43). Analytical units in higher resiliency categories are at less risk from potential stochastic events, such as extreme weather events, than analytical units in lower resiliency categories. The SSA provides additional detail regarding the methodology we used to evaluate resiliency for each of the three analytical units (Service 2022, pp. 36-43).

Table 1. Condition Category Table: the demographic and habitat factors used to categorize the resiliency of clay-loving wild buckwheat analytical units. An analytical unit's resiliency is calculated by weighting each metric equally and calculating the overall score. A green shading indicates a high score, yellow indicates a moderate score, and red indicates a low score.

Condition Category Table							
Condition Category	**Individual Needs / Habitat Factors**			**Analytical Unit Needs / Demographic Factors**			**Overall Condition**
	Habitat Condition Index	**Climate Metric**		**Seedling Frequency**	**10-year Average Analytical Unit Growth Rate**	**F_{st}**	
Need being Measured	Substrate Structure and Characteristics	Soil Moisture	Soil Temperature	Analytical Unit Abundance Distributed across Age Classes	Analytical Unit Growth Rate and Recruitment	Connectivity	Total Score
High (healthy)	> 2.33	Fall/winter precipitation AND spring temperature are good.		> 20%	$\lambda > 1$	$F_{st} < 0.05$	11.67 – 15
Moderate (moderately healthy)	1.67 - 2.33	Fall/winter precipitation OR spring temperature is good.		10 - 20%	$\lambda = 1$	0.05 - 0.15	8.34 – 11.66
Low (unhealthy)	< 1.67	Fall/winter precipitation AND spring temperature are bad.		< 10%	$\lambda < 1$	$F_{st} > 0.15$	5 – 8.33

Table 2 summarizes our evaluation of current resiliency for each analytical unit. Of the three analytical units, two units—Fairview and Selig—have moderate resiliency, and one unit—Delta—has low resiliency. For this species, the differences in overall current condition between each analytical unit are driven by differences in habitat size, habitat type, and in climate.

Table 2. Measure of current resiliency in each clay-loving wild buckwheat analytical unit based on current habitat conditions and demographics. A green shading indicates a high score, yellow indicates a moderate score, and red indicates a low score.

Current Condition								
	Individual Needs / Habitat Factors			**Analytical Unit Needs / Demographic Factors**			
	Habitat Condition Index	**Climate Metric**		**Seedling Frequency**	**10-year Average Analytical Unit Growth Rate**	**F_{st}**	**Overall Condition**
Analytical Unit	Substrate Structure and Characteristics	Soil Moisture	Soil Temperature	Analytical Unit Abundance Distributed across Age Classes	Analytical Unit Growth Rate and Recruitment	Connectivity	
Fairview Analytical Unit	HIGH	LOW		LOW	LOW	HIGH	MODERATE
Selig Analytical Unit	MODERATE	MODERATE		LOW	LOW	HIGH	MODERATE
Delta Analytical Unit	LOW	LOW		LOW	LOW	HIGH	LOW

The SSA provides a full account of our evaluation of resiliency for each analytical unit, including the assessment of each habitat and demographic factor for each analytical unit. See the SSA for our full analysis of current resiliency (Service 2022, pp. 44-48).

Summary of Current Redundancy and Representation

Redundancy for narrow endemic species is inherently limited, and redundancy of clay-loving wild buckwheat is at risk of further decline due to the lack of any highly resilient analytical units and low numbers of plants. Additionally, clay-loving wild buckwheat plants are distributed unevenly across the range of the species with most plants occurring in the Fairview analytical unit. In the event of a catastrophe in the Fairview analytical unit (e.g., a wildfire), a disproportionate number of plants would be lost, significantly impacting the viability of the species. The three analytical units also border one another and cover only 162 square miles (420 square kilometers), further limiting the redundancy of the species and its ability to withstand catastrophic events.

In terms of representation, the species exhibits some ecological variability (i.e., precipitation and temperature regimes vary across the species' range). Generally, precipitation increases and temperature decreases along a north to south gradient (i.e., precipitation is highest and temperatures are lowest in the Fairview analytical unit). The species also maintains limited genetic diversity and high connectivity within and among analytical units. These forms of representation give the species some, albeit limited, ability to adapt to changing environmental conditions (e.g., warming or drought).

Summary of Future Condition from the SSA

We projected the resiliency of clay-loving wild buckwheat analytical units and the redundancy and representation of the species over the next 33 years (i.e., 2055) using a range of plausible future scenarios. We are uncertain of a specific timescale that is biologically relevant to this species, since we do not know its full lifespan or generation time; thus, we relied on the timeframe over which we could reliably project climate condition and land management actions to establish the time period for our future condition analysis. We selected a timeframe of 33 years because this timeframe is short enough for us to realistically predict changes in climate conditions, species' stressors, and conservation efforts, yet long enough to begin to understand the response of ecosystems to those changes. To evaluate future conditions, we used the same methodology that we used to evaluate current condition, but instead considered the plausible conditions for the three habitat factors and three demographic factors projected into the future under a range of plausible future scenarios.

Below we summarize the future scenarios and our evaluation of future condition under each scenario. Our full analysis of future conditions is in the SSA (Service 2022, pp. 48-58).

Summary of Future Scenarios

We used scenario planning to describe plausible futures for clay-loving wild buckwheat and to capture uncertainty associated with our future projections. Future scenarios allowed us to explore a range of possible future conditions for clay-loving wild buckwheat, given the uncertainty in the stressors clay-loving wild buckwheat may face, the species' potential response to those stressors, and the potential for possible conservation efforts to influence future conditions. As described in more detail in the SSA (Service 2022, pp. 48-52), we developed one optimistic future scenario, one continuation of current trends future scenario, and one pessimistic future scenario:

- **Optimistic Future Scenario**: Under this scenario, current conservation efforts remain in place, additional critical habitat is designated, conservation plans with utility companies are developed, the rate of development is low, and precipitation increases;
- **Continuation of Current Trends Future Scenario**: Under this scenario, current conservation efforts remain in place, development continues at its current rate, and precipitation increases, but water uptake by plants is slowed by a four-degree increase in average spring temperature;
- **Pessimistic Future Scenario:** Under this scenario, current conservation efforts decrease and restrictions on grazing, OHV use, and development are lifted. The rate of development increases and the climate becomes unfavorable for clay-loving wild buckwheat with no increase in precipitation and large increases in average spring temperature, effectively drying out the soil.

Although there are likely different probabilities associated with our future scenarios, all scenarios described here are plausible; we did not include scenarios that are unlikely to occur. Therefore, we do not forecast which future scenario we predict is most likely; rather, the three future scenarios are designed to capture the range of plausible conditions clay-loving wild buckwheat may experience within the projected timeline.

We used the same methodology that we used to evaluate current condition to project the resiliency for the three analytical units into mid-century: we projected the future condition for the three habitat factors and four demographic factors for each of the three future scenarios and then calculated an overall resiliency score for each analytical unit under each scenario using the same methodology as our current condition evaluation. After evaluating resiliency, we then evaluated redundancy and representation for each future scenario.

Summary of Future Conditions by Scenario

Optimistic Future Scenario: Resiliency of the Fairview analytical unit increases and moves to a "high" condition, the Selig and Delta analytical units remain in "moderate" and "low" condition, respectively. Designation of additional critical habitat and continued restrictions on grazing, OHV use, and development, allow for some passive restoration of clay-loving wild buckwheat habitat and prohibit additional disturbances from impacting the analytical units. Most notably, fall and winter precipitation increases by about one inch, meaning more water is available for germination, growth, and reproduction. Because of the continued restrictions on ground-disturbing activities and increases in fall and winter precipitation, we anticipate the ten-year average analytical unit growth rate to increase under this scenario for all three analytical units.

In the Selig and Delta analytical units, improvements in precipitation are outpaced by increases in soil temperature. Spring temperatures average more than 51 °F (10.5 °C) which will reduce the recharge of moisture in the soil profile and the plants' ability to uptake water. This may stress plants and cause reduced reproduction as clay-loving wild buckwheat individuals are known to enter into whole plant dormancy in times of stress. This increase in average spring temperature results in a "low" rank for the climate metric for the Selig and Delta analytical units and lowers the overall resiliency of those units (Table 3). Redundancy and representation for this species may increase slightly under this scenario compared to current condition, due to an increase in resiliency in the Fairview analytical unit.

Table 3. Measure of future resiliency in each clay-loving wild buckwheat analytical unit based on habitat conditions and demographics under an optimistic scenario. A green shading indicates a high score, yellow indicates a moderate score, and red indicates a low score.

Optimistic Scenario								
	Individual Needs / Habitat Factors			**Analytical Unit Needs / Demographic Factors**			
	Habitat Condition Index	**Climate Metric**		**Seedling Frequency**	**10-year Average Analytical Unit Growth Rate**	**F_{st}**	**Overall Condition**
Analytical Unit	Substrate Structure and Characteristics	Soil Moisture	Soil Temperature	Analytical Unit Abundance Distributed across Age Classes	Analytical Unit Growth Rate and Recruitment	Connectivity	
Fairview Analytical Unit	HIGH	MODERATE		MODERATE	MODERATE	HIGH	HIGH
Selig Analytical Unit	MODERATE	LOW		LOW	MODERATE	HIGH	MODERATE
Delta Analytical Unit	LOW	LOW		LOW	MODERATE	HIGH	LOW

Continuation of Current Trends Future Scenario: In the continuation scenario, compared to current condition, resiliency declines across all three analytical units. The Selig analytical unit moves to a "low" condition, meaning two of the species' three analytical units would be in "low" condition. The Fairview analytical unit remains in "moderate" condition (Table 4). Though land management prescriptions are similar to current land management under this scenario, climatic conditions worsen due to continuation of current climate trends. Cumulative fall and winter precipitation increases by three-quarters of an inch, but the increase in precipitation is outpaced by average spring temperatures that climb by at least 4 °F. Warmer spring temperatures will reduce the recharge of moisture in the soil profile and the plant's ability to uptake water. All analytical units will likely experience a reduction in growth and reproduction. Plants across the species' range may exhibit whole plant dormancy or mortality, especially in the Delta analytical unit where spring temperatures are expected to average more than 55 °F (12.8 °C). Redundancy and representation for this species may decrease under this scenario compared to current condition, due to decreased resiliency across all three analytical units.

Table 4. Measure of future resiliency in each clay-loving wild buckwheat analytical unit based on habitat conditions and demographics under a continuation of current trends scenario. A green shading indicates a high score, yellow indicates a moderate score, and red indicates a low score.

Continuation Scenario								
	Individual Needs / Habitat Factors			**Analytical Unit Needs / Demographic Factors**			
	Habitat Condition Index	**Climate Metric**		**Seedling Frequency**	**10-year Average Population Growth Rate**	**F_{st}**	
Analytical Unit	Substrate Structure and Characteristics	Soil Moisture	Soil Temperature	Analytical Unit Abundance Distributed across Age Classes	Analytical Unit Growth Rate and Recruitment	Connectivity	**Overall Condition**
Fairview Analytical Unit	HIGH	LOW		LOW	LOW	HIGH	MODERATE
Selig Analytical Unit	MODERATE	LOW		LOW	LOW	HIGH	LOW
Delta Analytical Unit	LOW	LOW		LOW	LOW	HIGH	LOW

Pessimistic Future Scenario: In the pessimistic scenario, compared to current condition, resiliency declines for all analytical units. All analytical units now rank as "low" (Table 5). In this scenario, land management is less favorable to clay-loving wild buckwheat, and grazing, OHV use, and development in clay-loving wild buckwheat habitat increase. This further fragments the analytical units and causes the loss of plants and habitat. The climate also becomes less favorable. Cumulative fall and winter precipitation does not increase in any analytical unit, and average spring temperatures are greater than 55 °F (12.8 °C). Connectivity also begins to decrease as plants are lost and fragmentation increases. All analytical units experience reductions in growth, reproduction, and abundance as plants go dormant or die. Redundancy and representation for this species may decrease under this scenario compared to current condition, due to decreases in resiliency at all three analytical units.

Table 5. Measure of future resiliency in each clay-loving wild buckwheat analytical unit based on habitat conditions and demographics under a pessimistic scenario. A green shading indicates a high score, yellow indicates a moderate score, and red indicates a low score.

Pessimistic Scenario								
	Individual Needs / Habitat Factors			**Analytical Unit Needs / Demographic Factors**			**Overall Condition**
	Habitat Condition Index	**Climate Metric**		**Seedling Frequency**	**10-year Average Analytical Unit Growth Rate**	**F_{st}**	
Analytical Unit	Substrate Structure and Characteristics	Soil Moisture	Soil Temperature	Analytical Unit Abundance Distributed across Age Classes	Analytical Unit Growth Rate and Recruitment	Connectivity	
Fairview Analytical Unit	MODERATE	LOW		LOW	LOW	HIGH	LOW
Selig Analytical Unit	LOW	LOW		LOW	LOW	MODERATE	LOW
Delta Analytical Unit	LOW	LOW		LOW	LOW	MODERATE	LOW

Summary of Viability from SSA

Viability is the "ability of a species to sustain populations in the wild over time" (Service 2016, p. 21). Taken together, current and future levels of resiliency, redundancy, and representation characterize the viability of clay-loving wild buckwheat. Currently, none of the analytical units demonstrate high resiliency (Table 2). Two of the three analytical units—Fairview and Selig—have moderate resiliency and one analytical unit—Delta—has low resiliency. Additionally, range-wide monitoring efforts have demonstrated a decreasing trend in plant density over the last ten years in all analytical units.

Redundancy for narrow endemic species is inherently limited, and redundancy of clay-loving wild buckwheat is at risk of further decline due to the lack of any highly resilient analytical units and low numbers of plants. Redundancy is influenced by resiliency in that analytical units with low resiliency are less able to spur recovery if there is a catastrophic event which destroys another analytical unit (e.g., wildfire). Additionally, plants are distributed unevenly across the range of the species with most occurring in the Fairview analytical unit. The range of the three analytical units is contained within a relatively small area of 162 square miles (420 square kilometers) which further limits the redundancy of the species and the ability of clay-loving wild buckwheat to withstand a catastrophic event.

In terms of representation, the species exhibits some ecological variability (i.e., precipitation and temperature regimes vary across the species' range) and maintains limited genetic diversity and high connectivity within and among analytical units.

Around mid-century, there are improvements or reductions in resiliency across the three analytical units, depending on the scenario. Under the optimistic scenario, resiliency is expected to increase slightly for the Fairview analytical unit. Redundancy and representation of the species may also increase as resiliency of the Fairview analytical unit increases. Under the continuation and pessimistic future scenarios, changes in climate will likely reduce the resiliency of each analytical unit. With only three known analytical units, the loss of one due to catastrophic, natural, or human-caused events would cause a severe loss of redundancy and representation of the species. Redundancy and representation of the species becomes less secure as resiliency of each analytical unit decreases.

STATUS RECOMMENDATION

Standard for Review

Section 4 of the Act (16 U.S.C. Section 1533) and its implementing regulations (50 CFR part 424) set forth the procedures for determining whether a species meets the definition of

"endangered species" or "threatened species." The Act defines an "endangered species" as a species that is "in danger of extinction throughout all or a significant portion of its range," and a "threatened species" as a species that is "likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range." The Act requires that we determine whether a species meets the definition of an "endangered species" or a "threatened species" because of any of the following factors:

> (A) The present or threatened destruction, modification, or curtailment of its habitat or range;
> (B) Overutilization for commercial, recreational, scientific, or educational purposes;
> (C) Disease or predation;
> (D) The inadequacy of existing regulatory mechanisms; or
> (E) Other natural or manmade factors affecting its continued existence.

These factors represent broad categories of natural or human-caused actions or conditions that could have an effect on a species' continued existence. In evaluating these actions and conditions, we look for those that may have a negative effect on individual clay-loving wild buckwheat, as well as other actions or conditions that may ameliorate any negative effects or may have positive effects.

We use the term "threat" to refer in general to actions or conditions that are known to or are reasonably likely to negatively affect individuals of a species. The term "threat" includes actions or conditions that have a direct impact on individuals, as well as those that affect individuals through alteration of their habitat or required resources. The term "threat" may encompass—either together or separately—the source of the action or condition, or the action or condition itself.

However, the mere identification of any threat(s) does not necessarily mean that the species meets the Act's definition of an "endangered species" or a "threatened species." In assessing whether a species meets either definition, we must evaluate all identified threats by considering the effects of the threats and the expected response of the species—in light of those actions and conditions that will ameliorate the threats—on an individual, population, and species level. We evaluate each threat and its expected effects on the species, then analyze the cumulative effect of all of the threats on the listable entity as a whole. We also consider the cumulative effect of the threats in light of those actions and conditions that will have positive effects on the species—such as any existing regulatory mechanisms or conservation efforts. The Service recommends whether the species meets the definition of an "endangered species" or a "threatened species" only after conducting this cumulative analysis and describing the expected effect on the species now and in the foreseeable future.

In our status recommendation, we correlate the threats acting on clay-loving wild buckwheat to the factors in section 4(a)(1) of the Act. We summarize our five-year status review for clay-loving wild buckwheat below.

Summary of Analysis

The biological information we reviewed and analyzed as the basis for our finding is documented in the SSA (Service 2022, entire), a summary of which is provided above. The projections for the future condition of clay-loving wild buckwheat are based on our expectations of the potential stressors and conservation efforts that may affect the species. When we listed clay-loving wild buckwheat as an endangered species on July 13, 1984, we identified habitat loss due to livestock grazing and associated OHV use as the primary threats to the species (Factor A; 49 FR 28562).

In the SSA, we evaluated incompatible livestock grazing and OHV use as well as additional stressors, including invasive species (Factor A), commercial and residential development (Factor A), irrigation operations (Factor A), development and maintenance of utility corridors (Factor A), and climate change (Factor A; Service 2022, pp. 28-33). These stressors are interrelated to varying degrees; for example, OHV use is related to the introduction and presence of invasive species on the landscape. Lastly, we evaluated potential cumulative effects of these stressors.

We also evaluated a variety of conservation efforts across the three analytical units that either reduce or ameliorate stressors, or improve habitat (Service 2022, pp. 33-35). These conservation efforts include special land designations, fencing and exclosures, no surface occupancy stipulations, and several ongoing monitoring efforts (Service 2022, pp. 33-35). These conservation efforts help address the stressors identified under Factors A. However, these regulatory mechanisms (Factor D) do not fully address all of the stressors identified, most notably climate change.

We note that by using the SSA framework to guide our analysis of the best available scientific information, we have analyzed the effects of stressors on individuals, on analytical units, and on clay-loving wild buckwheat as a species, as well as the stressors' potential cumulative effects (Service 2022, entire). We incorporate the cumulative effects into our analysis when we characterize the current and future condition of clay-loving wild buckwheat. Our current and future condition assessment is iterative because it accumulates and evaluates the effects of all the factors that may be influencing clay-loving wild buckwheat, including negative influences from stressors and positive influences from conservation efforts. We evaluate potential effects from these influences consistently across the same subset of habitat and demographic needs, both currently and into the future. Because the SSA framework considers not just the presence of the factors, but also the degree to which they collectively influence risk to the entire listed entity, our

assessment integrates the cumulative effects of the five factors and replaces a standalone cumulative effects analysis.

We also consider estimates of density over time to effectively illustrate cumulative impacts to the population. Density estimates capture the effects of all of the various stressors and conservation efforts on the species and its habitat. The best available data indicate that clay-loving wild buckwheat densities are decreasing across the species' range.

Application of Analysis to the Status Recommendation

The SSA describes the current and future viability of clay-loving wild buckwheat in terms of the 3Rs, which characterize risk to clay-loving wild buckwheat in the context of stochasticity (resiliency), catastrophes (redundancy), and long-term environmental change (representation) (Service 2022, entire). This analysis forms the basis for our recommendation under the Act. Because of uncertainties regarding the future, we evaluated future condition for three plausible future scenarios designed to capture the relevant uncertainties regarding future stressors and conservation efforts. The fundamental question before the Service is whether the projections of extinction risk, described in the SSA in terms of the resiliency, redundancy, and representation of clay-loving wild buckwheat, under a range of future scenarios, indicate that the listed entity meets the definition of an endangered or threatened species under the Act. Theoretically, if the resiliency, redundancy, and representation of clay-loving wild buckwheat decreases, thereby decreasing overall viability, the extinction risk of clay-loving wild buckwheat would correspondingly increase.

As described below, we first evaluate whether clay-loving wild buckwheat is in danger of extinction throughout its range now. If not, we then evaluate whether clay-loving wild buckwheat is likely to become in danger of extinction throughout its range in the foreseeable future. Finally, if applicable, we consider whether clay-loving wild buckwheat is in danger of extinction in a significant portion of its range (SPR).

Evaluation of Status: In Danger of Extinction Throughout its Range

Under the Act, an endangered species is any listable entity that is "in danger of extinction throughout all or a significant portion of its range" (16 U.S.C. Section 1532(6)). For this five-year status review, we evaluate the best available scientific information about the species' current and future condition to describe the viability of clay-loving wild buckwheat (Service 2022, entire). We compare our evaluation of the species' current risk of extinction against the definition of an endangered species.

Though we are now aware of more occurrences of clay-loving wild buckwheat since the species' original listing, most occurrences show substantial declines in plant density over the last five to ten years. These declines are primarily attributed to drought and to increases in spring temperature and are reflected in the low to moderate resiliency of each analytical unit. Currently, two of the species' three analytical units—Fairview and Selig—have moderate resiliency, and one analytical unit—Delta—has low resiliency. Though ongoing conservation measures have helped address many of the threats to clay-loving wild buckwheat, such as OHV use and incompatible livestock grazing, these stressors continue to impact the species and its habitat, and none of these conservation efforts address the impacts of the drier, hotter conditions clay-loving wild buckwheat occurrences are currently experiencing. The drier, hotter conditions also make clay-loving wild buckwheat more vulnerable to impacts from the species' other stressors.

Redundancy for narrow endemic species is inherently limited, and redundancy of clay-loving wild buckwheat is at risk of further decline due to the lack of any highly resilient analytical units and low numbers of plants. Additionally, clay-loving wild buckwheat plants are distributed unevenly across the range of the species with most plants occurring in the Fairview analytical unit. In the event of a catastrophe in the Fairview analytical unit (e.g., a wildfire), a disproportionate number of plants would be lost, significantly impacting the viability of the species. The three analytical units also border one another and cover only 162 square miles (420 square kilometers), further limiting the redundancy of the species and its ability to withstand catastrophic events.

In terms of representation, the species exhibits some ecological variability (i.e., precipitation and temperature regimes vary across the species' range). Generally, precipitation increases and temperature decreases along a north to south gradient (i.e., precipitation is highest and temperatures are lowest in the Fairview analytical unit). The species also maintains limited genetic diversity and high connectivity within and among analytical units. These forms of representation give the species some, albeit limited, ability to adapt to changing environmental conditions (e.g., some warming or drought).

Given the current moderate and low levels of resiliency of each analytical unit, range-wide decreasing plant densities, and the current, ongoing unfavorable climatic conditions, we believe that clay-loving wild buckwheat does not currently have sufficient ability to withstand stochastic and catastrophic events, or sufficient ability to adapt to environmental changes. Therefore, we conclude that the current risk of extinction is high, such that clay-loving wild buckwheat is currently in danger of extinction throughout all of its range.

Evaluation of Status: Likely to Become Endangered Throughout its Range

Having determined that clay-loving wild buckwheat is in danger of extinction throughout its range, we have not considered whether the listed entity is likely to become endangered throughout its range.

Evaluation of Status Throughout a Significant Portion of its Range

Having determined that clay-loving wild buckwheat is in danger of extinction throughout its range, we have not considered whether the listed entity may be in danger of extinction in a significant portion of its range.

Summary of Evaluation and Recommendation

Our review of the best available scientific and commercial information indicates that clay-loving wild buckwheat meets the definition of an endangered species in accordance with Section 3(6) and 3(20) of the Act. Therefore, with this five-year status review, we recommend that clay-loving wild buckwheat retain its status as an endangered species under the Act.

U.S. FISH AND WILDLIFE SERVICE
FIVE-YEAR STATUS REVIEW FOR
CLAY-LOVING WILD BUCKWHEAT
(*Eriogonum pelinophilum*)

CURRENT CLASSIFICATION: Endangered

RECOMMENDATION RESULTING FROM THIS FIVE-YEAR STATUS REVIEW:

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

REGIONAL OFFICE APPROVAL:

Approved by: ANN TIMBERMAN Digitally signed by ANN TIMBERMAN Date: 2022.08.31 17:41:03 -06'00' Date: _____

for: Nicole Alt
U.S. Fish and Wildlife Service
Field Supervisor
Colorado Ecological Services
Mountain-Prairie Region, Region 6

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