GRAHAM'S BEARDTONGUE
(*PENSTEMON GRAHAMII*)
AND
WHITE RIVER BEARDTONGUE
(*P. SCARIOSUS* VAR. *ALBIFLUVIS*)

BIOLOGICAL STATUS REPORT
OF
FUTURE CONDITION

Figure 1. Photos of Graham's beardtongue (left) and White River beardtongue (right). Photos by Kevin Megown and Jessi Brunson.

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This document was prepared by:
Jennifer Lewinsohn, Botanist, Utah Ecological Services Field Office

This document was reviewed by:
Paul Abate, Branch Supervisor, Utah Ecological Services Field Office
Laura Romin, Assistant Field Supervisor, Utah Ecological Services Field Office
Sarah Backsen, DOI Region 5&7 Branch Chief

EXECUTIVE SUMMARY

This report summarizes the results of our projected future scenarios for Graham's beardtongue (*Penstemon grahamii*) and White River beardtongue (*Penstemon scariosus* var. *albifluvis*) to evaluate each species' overall viability. For the purposes of this report, we defined viability as the ability of Graham's and White River beardtongues to sustain wild populations over time. We evaluated the beardtongues' projected future viability using the three conservation biology principles of resiliency, representation, and redundancy (together, the 3Rs) (U.S. Fish and Wildlife Service [USFWS] 2020, pp. 11 - 13). Using the 3Rs, we evaluated the future viability of the beardtongues based on the presence of multiple (redundancy), self-sustaining (resiliency) populations distributed across the range of the species, and their contributions to adaptive capacity (representation) in the face of changing environmental conditions. We relied on our recent characterization of each species' current condition, stressors, and effects of stressors as the baseline from which to evaluate future changes to those factors considered important to the beardtongues (USFWS 2020a, entire).

Graham's and White River beardtongues are long-lived perennial plant species that flower in the spring and require pollinators for maximum reproduction. The beardtongues have highly specific soil requirements and occupy exposed oil shale soils of the Green River geologic formation. They require suitable intact soils with microsites for establishment and growth. The health (long-term productivity) of populations is affected by the population size, habitat quantity, and habitat quality available to support stable or increasing populations.

Graham's beardtongue occurs in 27 populations across 5 range units, with a total population of 55,820 individuals, across the Uintah Basin in Duchesne and Uintah Counties in Utah and Rio Blanco County in Colorado (USFWS 2020a, entire). White River beardtongue occurs in 17 populations across 5 range units, with a total population of 31,005 individuals, across the Uintah Basin and at an isolated location in the Book Cliffs in Grand and Uintah Counties in Utah and Rio Blanco County in Colorado (USFWS 2020a, entire). The occupied habitat area for Graham's and White River beardtongues is 9,585 acres (ac) and 3,462 ac of habitat, respectively. Habitat for the species' pollinators includes beardtongue occupied habitat and a larger pollinator foraging area, equaling 91,232 ac and 29,476 ac, for Graham's and White River beardtongue, respectively.

To assess future resiliency, we evaluated relevant habitat and demographic factors to calculate an overall condition score for each plant population. We evaluated population size, habitat area, habitat quality, and habitat loss for the future condition. Based on the results of these evaluations we rated population condition Good, Moderate, Low, or Extirpated. Some populations were rated Moderate or Low without an energy stressor because their overall condition score was inherently low as a result of their habitat and demographic factor scores. In our assessment, high overall viability means having more populations in Good to Moderate condition. To assess future redundancy, we evaluated the projected number and distribution of populations within the species range relative to the current condition. To assess future representation, we evaluated the projected demographic (population size) and ecological (ecological settings) surrogates of genetic diversity relative to the current condition.

Based on input received from Federal and state agencies, private industry, and the best available information, we developed two plausible future scenarios which include moderate and high levels of energy development. These two scenarios considered impacts to the beardtongues through 2030, because we have sufficient information to project out to 10 years for energy development (oil shale, tar sands, and oil and gas development), which is the primary future stressor for the beardtongues. Beyond 10 years, there is too much uncertainty about the level or distribution of energy development within the beardtongues' populations and ranges, such that projections would become speculative. In the locations where energy stressors occurred for the two scenarios, our analysis included the following assumptions: commercial development activities for oil shale and tar sands will occur in the next 10 years; and the total loss of plants and habitat will occur where oil shale and tar sands are projected. These conservative assumptions allowed us to evaluate worst-case impacts from energy development, to bracket the full range of energy development impacts to the beardtongues that may occur, since actual future impacts may range anywhere from their current condition to the future scenarios evaluated here, or may fall in between. We did not develop a scenario that considered "exploration-only" activities for oil shale and tar sands with a smaller surface disturbance extent, even though it would also be a plausible future forecast for oil shale and tar sands. Our evaluation of effects from energy development accounted for the protections afforded to the beardtongues from a 2014 conservation agreement (2014 CA) between the USFWS, Bureau of Land Management (BLM), Utah School and Institutional Trust Lands Administration (SITLA), Utah Public Lands Coordination Office (PLPCO), Utah Division of Wildlife Resources (UDWR), Uintah County in Utah, and Rio Blanco County in Colorado that is in place through 2034.

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For the two future scenarios, we forecasted the species' biological condition based on conservation efforts and the following stressors: oil shale, tar sands, and traditional oil and gas; road construction and maintenance; herbivory; invasive weeds; and climate change. Our future scenarios varied based on two forecasts for oil shale (moderate, high). We did not develop more than one forecast for the other stressors (tar sands, traditional oil and gas, road construction and maintenance; herbivory; invasive weeds; and climate change) because their future, plausible extents are not expected to vary much within the beardtongues' ranges independent of the oil shale stressor.

The two future scenarios we evaluated include:

Scenario 1 – Moderate energy development: We evaluated the future condition of beardtongue populations based on potential impacts from stressors (oil shale, tar sands, and traditional oil and gas; road construction and maintenance; herbivory; invasive weeds; and climate change) and the benefits from conservation efforts. We projected that oil shale exploration and commercial development would occur on lands identified as having a high potential for both activities. The effects of herbivory and invasive weeds may increase in populations that overlap with energy development. Climate change may contribute to stronger effects from herbivory and invasive weeds to all beardtongue populations.

Scenario 2 – High energy development: We evaluated the future condition of beardtongue populations based on potential impacts from stressors (oil shale, tar sands, and traditional oil and gas; road construction and maintenance; herbivory; invasive weeds; and climate change) and the benefits from conservation efforts. We projected that oil shale exploration and commercial development would occur over a larger area that included the same lands as the moderate scenario, plus other lands identified as likely or about as likely as not to support these activities. The potential effects of the other stressors remained the same as evaluated for the moderate energy development scenario.

We acknowledge that our scenarios are projections and may not accurately forecast future events. However, we used the best available science and information for our scenarios and analyses and acknowledged any key assumptions and uncertainties throughout this report. The scenarios we chose are not necessarily the most likely to occur. Rather, they are intended to bracket the full range of plausible future outcomes. Our projections of each species' future viability vary between the moderate and high energy development scenarios, as described below.

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Under the moderate energy development scenario, oil shale and traditional oil and gas are the main stressors for Graham's beardtongue, and oil shale is the main stressor for White River beardtongue. In this scenario, these stressors are projected to result in plant and habitat loss in the center of the species' ranges (Table 1; Table 2).

- For Graham's beardtongue, there is a projected loss of 34 percent of the total population (direct loss of 19,029 plants) from energy development, with a remaining total population size of 36,791 individuals in 24 populations. Remaining occupied habitat and pollinator habitat losses are projected to be 7,642 and 72,455 acres, respectively. The main stressors (i.e., oil shale and traditional oil and gas development) result in the extirpation of three populations and a decline in the condition of four populations compared to their current condition. The current population condition is maintained in the other 20 populations. The species continues to occupy the extent of its current range, and all five range units continue to support populations in Good or Moderate condition. Fourteen populations in Good and Moderate condition are large in size and have a low extinction risk (< 5 percent over 50 years).
- For White River beardtongue, there is a projected loss of one percent of the total population (direct loss of 216 plants) from energy development, with a remaining total population size of 30,789 individuals in 16 populations. Remaining occupied habitat and pollinator habitat are projected to be 3,218 and 26,959 acres, respectively. The main stressor (i.e., oil shale development) results in the extirpation of one population and a decline in the condition of one population compared to their current condition. The current population condition is maintained in the other 14 populations. The species continues to occupy the extent of its current range and all five range units continue to support populations in Good or Moderate condition. Eleven populations in Good and Moderate condition are large in size and have a low extinction risk (< 5 percent over 50 years).
- Despite the extirpation of populations, levels of redundancy remain high for both species with Graham's beardtongue maintaining 24 populations and White River beardtongue maintaining 16 populations.
- Graham's beardtongue maintains 14 large populations distributed across its range and continues to occupy the five main vegetation types within its range. Our evaluation of representation indicates that Graham's beardtongue maintains a similar level of

ecological diversity within the 24 remaining populations to what it has currently, and should have the adaptive capacity to tolerate future climate and habitat conditions. We have no information to indicate that the projected loss of the three Graham's beardtongue populations (9, 10, 16), and projected plant loss in other populations would result in significant impacts to Graham's beardtongue's representation.

- White River beardtongue maintains 11 large populations distributed across its range and continues to occupy the five main vegetation types within its range. Our evaluation of representation indicates that White River beardtongue maintains a similar level of ecological diversity within the 16 remaining populations to what it has currently, and should have the adaptive capacity to tolerate future climate and habitat conditions. We have no information to indicate that the projected loss of the one White River beardtongue population (8), and projected plant loss in other populations would result in significant impacts to White River beardtongue's representation.

Under the high energy development scenario, the main stressors remain the same for the beardtongues:~~;~~ oil shale and traditional oil and gas are the main stressors for Graham's beardtongue and oil shale is the main stressor for White River beardtongue. Oil shale impacts result in more extensive plant and habitat loss in the center of the species' ranges than in the moderate energy development scenario (Table 1; Table 2).

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- For Graham's beardtongue, there is a projected loss of 46 percent of the total population (direct loss of 25,585 plants) from energy development, with a remaining total population size of 30,235 individuals in 24 populations. Remaining occupied habitat and pollinator habitat are projected to be 6,037 and 63,580 acres, respectively. The main stressors (i.e., oil shale and traditional oil and gas development) result in the extirpation of three populations and a decline in the condition of six populations compared to their current condition. The current population condition is maintained in the other 18 populations. Fourteen populations in Good and Moderate condition are large in size and have a low extinction risk (< 5 percent over 50 years). The species continues to occupy the extent of its current range and all five range units continue to support populations in Good or Moderate condition.
- For White River beardtongue, there is a projected loss of 23 percent of the total population (direct loss of 7,207 plants) from energy development, with a remaining total population size of 23,798 individuals in 15 populations. Remaining occupied habitat and pollinator habitat are projected to be 2,317 and 20,099 acres, respectively. The main stressor (i.e., oil shale development) results in the extirpation of two populations and a decline in the condition of two population compared to their current condition. The current population condition is maintained in the other 11 populations. Nine populations in Good and Moderate condition are large in size and have a low extinction risk (< 5 percent over 50 years). The species continues to occupy the extent of its current range and all five range units continue to support populations in Good or Moderate condition.
- Despite the extirpation of populations, levels of redundancy remain high for both species with Graham's beardtongue maintaining 24 populations and White River beardtongue maintaining 15 populations.
- Graham's beardtongue maintains the same number of large populations (14) distributed across its range as Scenario 1, and continues to occupy the five main vegetation types

within its range. Our evaluation of representation indicates that Graham's beardtongue maintains a similar level of ecological diversity within the 24 remaining populations to what it has currently, and should have the adaptive capacity to tolerate future climate and habitat conditions. We have no information to indicate that the projected loss of the three Graham's beardtongue populations (9, 10, 16), and projected plant loss in other populations would result in significant impacts to Graham's beardtongues' representation.

- White River beardtongue maintains 10 large populations distributed across its range and continues to occupy the five main vegetation types within its range. Our evaluation of representation indicates that White River beardtongue maintains a similar level of ecological diversity within the 15 remaining populations to what it has currently, and should have the adaptive capacity to tolerate future climate and habitat conditions. We have no information to indicate that the projected loss of the two White River beardtongue populations (8, 13), and projected plant loss in other populations would result in significant impacts to White River beardtongue's representation.

Under both energy development scenarios, the impact of stressors to the species' populations depend on population size and condition. For both species, large populations in Good condition are less sensitive to plant and habitat loss than populations in Moderate or Low condition, because there is sufficient habitat area and population size remaining to support the overall population condition.

The 2014 CA provides protections for the beardtongues on Federal and state lands until July 25, 2034. During this time, the beardtongues are afforded the same level of protections on Federal and state lands within designated conservation areas. The 2014 CA identifies 42,993 acres of designated conservation areas that protect 42 percent of the Graham's beardtongue population (23,280 plants) in 13 populations, and 67 percent of the White River beardtongue population (20,813 plants) in 11 populations. Within designated conservation areas, protections include an avoidance buffer of 300 feet between disturbance and beardtongue plants as well as surface disturbance caps to restrict development. Surface disturbance caps would allow a limited amount of new construction for roads and traditional oil and gas development but would prohibit future oil shale and tar sand exploration and development.

The beardtongues are also afforded protections outside of designated conservation areas on Federal lands, which include: a 300 foot (ft) avoidance buffer; surface disturbance restrictions on steep slopes; areas that are unavailable for leasing or have no surface occupancy (NSO) stipulations; and designated Areas of Critical Environmental Concern (ACECs). Overall, the 2014 CA designated conservation areas and other conservation measures on Federal lands provide protections to 51 percent (28,277 plants) and 76 percent (23,698 plants) of the Graham's and White River beardtongue total population, respectively.

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Table 1. Summary of Graham's beardtongue population condition scores under current conditions and the moderate energy development (Scenario 1), and high energy development (Scenario 2) future scenarios.

Range Unit	Population	Current Condition	Future Condition: Scenario 1 Moderate Development	Future Condition: Scenario 2 High Development	Energy Stressor(s) for Scenario 1 (1), 2 (2), or Both (B)
1. Sand Wash	1	Good	Good	Good	Oil and gas (B)
	2	Good	Good	Good	None
	3	Good	Good	Good	None
	4	Moderate	Moderate	Moderate	None
	5	Good	Good	Good	None
	6	Good	Good	Good	None
2. Seep Ridge	7	Moderate	Moderate	Low	Oil shale(2)
	8	Moderate	Moderate	Moderate	None
	9	Moderate	Extirpated	Extirpated	Oil and gas (B)
	10	Good	Extirpated	Extirpated	Oil and gas (B)
	11	Moderate	Moderate	Moderate	Oil and gas (B); Oil shale (2)
	12	Moderate	Low	Low	Oil and gas (B); Oil shale (2)
	13	Good	Good	Good	Oil and gas (B); Oil shale (B)
	14	Good	Good	Good	None
	15	Good	Good	Moderate	Oil and gas (B); Oil shale (2)
	16	Moderate	Extirpated	Extirpated	Oil and gas (B)
3. Evacuation Creek	17	Good	Moderate	Moderate	Oil shale (B)
	18	Moderate	Moderate	Moderate	Oil shale (B)
	19	Moderate	Low	Low	Oil shale (B)
	20	Good	Good	Good	Oil shale (B)
	21	Moderate	Low	Low	Oil and gas (B)
	22	Good	Good	Good	oil and gas (B); oil shale (B)
4. White River	23	Good	Good	Good	Oil shale (2)
5. Raven Ridge	24	Moderate	Moderate	Moderate	None
	25	Moderate	Moderate	Moderate	None
	26	Moderate	Moderate	Moderate	None
	27	Good	Good	Good	None
Total Population		**55,820**	**36,791 (66%)**	**30,235 (54%)**	

Table 2. Summary of White River beardtongue population condition scores under current conditions and the moderate energy development (Scenario 1), and high energy development (Scenario 2) future scenarios.

Range Unit	Population	Current Condition	Future Condition: Scenario 1 Moderate Development	Future Condition: Scenario 2 High Development	Energy Stressor(s) for Scenario 1 (1), 2 (2), or Both (B)
2. Seep Ridge	1	Moderate	Moderate	Moderate	None
	2	Moderate	Moderate	Moderate	None
	3	Good	Good	Good	Oil shale (2)
	4	Good	Good	Good	Oil shale (2)
	5	Moderate	Moderate	Moderate	Oil shale (2)
	6	Moderate	Moderate	Moderate	None
	7	Moderate	Moderate	Moderate	None
3. Evacuation Creek	8	Low	Extirpated	Extirpated	Oil shale (B)
	9	Good	Moderate	Moderate	Oil shale (B)
4. White River	10	Good	Good	Good	Oil shale (B)
	11	Good	Good	Moderate	Oil shale (2)
	12	Moderate	Moderate	Moderate	Oil shale (2)
	13	Moderate	Moderate	Extirpated	Oil shale (2)
	14	Moderate	Moderate	Moderate	None
5. Raven Ridge	15	Moderate	Moderate	Moderate	None
	16	Good	Good	Good	None
6. Book Cliffs	17	Good	Good	Good	Oil and gas (B); Tar sands (B)
Total Population		**31,005**	**30,789 (99%)**	**23,798 (77%)**	

Table of Contents

Chapter 1. Introduction, Data, and Analytical Framework

This report is a technical document that evaluates Graham's and White River beardtongues' future biological status based on the best available scientific information. This report will be peer reviewed and this section will discuss substantial changes that were made between the draft and final reports. This report is not an Endangered Species Act (ESA) policy or decision document, and it does not predetermine the status of these species under the ESA. We did not organize our evaluation of threats to Graham's and White River beardtongues' using a five-factor analysis under the ESA. While this document is not a Species Status Assessment (SSA) Report, several concepts from the Service's SSA Framework (USFWS 2016, entire) are used in this report, such as the concepts of resilience, redundancy, and representation, as well as the organizational structure of future condition scenarios.

Future changes in energy exploration and mining for oil shale, tar sands, and traditional oil and gas, and the potential for cumulative effects of these three energy operations with livestock grazing, nonnative invasive species, and climate change are the stressors that may influence the future condition of Graham's and White River beardtongues (78 FR 47590, August 6, 2013; USFWS 2020a, entire). We developed our future condition evaluation based on these stressors, while acknowledging there is uncertainty on how these stressors may change singly and cumulatively, and their effects on each plant species.

This report describes the projected future extent and impact of stressors and characterizes the future condition of the beardtongues' populations. We used reliable projections of the future extent of stressors and conservation efforts based on the best available information and expert opinion (Chapter 2). We then evaluated each species projected future condition based on their biological needs, and the future status of stressors and conservation efforts (Chapter 3). Finally, we summarized the resiliency of the beardtongues' populations, and the redundancy and representation of the two species to describe their projected future viability (Chapter 4).

Below, we provide a summary of the data we used for our analyses, and the analytical framework we used to evaluate the viability of the two species. For more information on previous Federal actions for Graham's and White River beardtongues and the current condition of both species, please see the Biological Report (USFWS 2020a, p. 8).

1.1 Data

The occurrence data used for our analyses include compiled data from Utah Natural Heritage Program (UNHP) records, Bureau of Land Management (BLM) records, and published survey reports. In coordination with UNHP and BLM, we used a series of quality control checks to remove duplicative data and verify the spatial locations of plant records. For more information on occurrence data, please see the Biological Report (USFWS 2020a, p. 9).

We delineated plant populations by following standardized methods used by the national network of Natural Heritage Programs to identify the species' element occurrences (EO; (NatureServe 2004, p. 6). The EOs are plant points that are grouped together based on geographic proximity within a 1.24 mile distance separated by suitable habitat (NatureServe

2004, p. 6). Our population delineations differ from this protocol in a few instances where the distance slightly exceeded 1.24 miles. For the purpose of this assessment, we considered EOs to be synonymous with populations and hereafter will use the term “populations” when describing the distribution of the species.

We reported occupied habitat and pollinator habitat for the beardtongues, as defined in the Biological Report (USFWS 2020a, pp. 9 – 10). We defined the two habitat types as follows:

- Occupied habitat contains Graham’s beardtongue or White River beardtongue plants and their seedbanks. We delineated a 300 foot (ft) buffer area around plant locations as occupied habitat to account for seedbanks.
- Pollinator habitat contains beardtongue occupied habitat and a larger pollinator foraging area. We delineated a 2,297 ft buffer around Graham’s beardtongue plant locations and a 1,640 ft buffer area around White River beardtongue plant locations as pollinator habitat. The buffer distances are based on the foraging distance of each beardtongue’s largest pollinator (USFWS 2020a, pp. 10, 33 – 34).

We organized populations into range units separated by unoccupied gaps in the species’ ranges (USFWS 2020a, p. 10). Each beardtongue species occurs in five range units (units numbered 1 to 5 for Graham’s beardtongue and units numbered 2 to 6 for White River beardtongue), and the two species occur together in four of those range units (units 2 to 5) in the central and eastern portion of their ranges in Utah and Colorado. Range units also serve as metapopulations (a regional grouping of connected populations) for the two species (Malone 2014). A metapopulation delineation is helpful when evaluating the condition of populations in a given geographic area within each species’ range.

We held expert panel meetings on June 25, 2019, and March 5, 2020, to review and discuss pertinent information regarding the future locations and likelihood of energy development (oil shale, tar sands, and oil and gas development) at a geographic scale relevant to the beardtongues. This was necessary because other sources of information, including technical reports and published literature, generally provided information at a coarser scale (e.g. the Uintah Basin or the State of Utah) than what was needed for our analysis. Experts who participated in the panels included staff from the BLM, State of Utah Division of Oil, Gas, and Mining, State of Utah Geological Survey, and the energy development industry.

We used reliable projections of the likelihood a future event occurring and the future locations of stressors based on best available information and expert opinion. We used a published likelihood scale to elicit expert opinion and convey the likelihood of future occurrence with a consistent treatment of uncertainty (Table 3; Mastrandrea *et al*. 2010, p. 3). For more information on our expert panel meetings, please see the meeting notes (USFWS 2019, entire; USFWS 2020b, entire).

Table 3. Likelihood scale to estimate likelihood of future outcome.

Likelihood Descriptor	Likelihood of the Outcome
Virtually certain	99 – 100 % probability
Very likely	90 – 100% probability
Likely	66 – 100% probability
About as likely as not	33 – 66% probability
Unlikely	0 – 33% probability
Very unlikely	0 – 10% probability
Exceptionally unlikely	0 – 1% probability

The expert panel likelihood estimates and best available information from published literature and technical reports informed our ten year energy development (oil shale, tar sands, and oil and gas development) projection timeframe. Our evaluation determined that beyond a ten year timeframe, there was too much uncertainty to project energy development within the beardtongues' populations and ranges, such that projections would become speculative (USFWS 2019, entire; USFWS 2020b, entire).

1.2 Analytical Framework

To assess the viability of Graham's and White River beardtongues, we applied the conservation biology principles of resiliency, representation, and redundancy (the 3Rs, Chapter 6). Conservation programs are strengthened by adherence to the 3Rs (Shaffer and Stein 2000, pp. 308-311), and these principles are used by practitioners to develop conservation goals and prioritize areas for conservation efforts (Groves *et al*. 2002, pp. 506–509; Tear *et al*. 2005, p. 841; USFWS 2016, entire; Smith *et al.* 2018, p. 304). Viability is the ability of a species to sustain populations over time. To do this, a species must have a sufficient number and distribution of healthy populations to withstand changes in its biological (e.g., herbivores, disease) and physical (e.g., climate change) environment, environmental stochasticity (e.g., wet or dry, warm or cold years), and catastrophes (e.g., severe and prolonged droughts).

Viability is not a single state such as viable or not viable; rather, there are degrees of viability such as less to more viable, or low to high viability (Shaffer and Stein 2000, p. 310; Wolf *et al.* 2015, p. 204; USFWS 2016, entire; Smith *et al.* 2018, p. 304). Generally speaking, the more resiliency, representation, and redundancy a species has, the more protected it is against environmental variation; the more tolerance it has to stressors (one or more factors that may be acting on the species or its habitat, causing a negative effect) on the landscape; and the better able it is to adapt to future changes in environmental conditions. In short, we used the 3Rs framework to assess the health, number, and distribution of Graham's and White River beardtongues' populations across their current range of adaptive diversity.

1.2.1. Resiliency

Population-level resiliency is the ability to sustain populations in the face of stochastic (random) disturbance (Smith *et al.* 2018, p. 304). Stochastic disturbance includes normal year-to-year variation in rainfall and temperatures, as well as unseasonal weather events such as drought, fire, flooding, and storms. Simply stated, resiliency is having the means to recover from bad years (e.g., drought). To be resilient at the species-level, there must be healthy populations that are able to sustain themselves through good and bad years. The healthier the populations and the greater number of healthy populations, the more resiliency a species possesses.

Resiliency is positively related to population size and growth rate and may be influenced by connectivity among populations. Generally, populations need abundant individuals within habitat patches of adequate area and quality to maintain survival and reproduction in spite of environmental variation (Smith *et al.* 2018, p. 304). To assess Graham's and White River beardtongues' future resiliency, we performed the same evaluation of relevant habitat and demographic factors as we did for the current condition and calculated an overall future condition score for each population (section 3.1, Development of Future Scenarios; USFWS 2020a, pp. 64 – 68). We compared the current and projected future resiliency of each population under two future scenarios (section 3.2, Moderate Energy Development; section 3.3, High Energy Development).

1.2.2. Redundancy

Species-level redundancy is the ability of a species to withstand catastrophic events (Smith *et al.* 2018, p. 304). Redundancy protects species against the unpredictable and highly consequential events for which adaptation is unlikely. In short, it is about spreading the risk. Redundancy is best achieved by having multiple, resilient populations distributed within the species' ecological settings and across the species' range (Wolf *et al.* 2015, p.5 ; Smith *et al.* 2018, p. 306 – 307). Having multiple populations reduces the likelihood that all populations are affected simultaneously, while having widely distributed populations reduces the likelihood of populations possessing similar vulnerabilities to a catastrophic event. Redundancy can be measured by population number, resiliency, spatial extent, and degree of connectivity.

To assess Graham's and White River beardtongues' future redundancy, we evaluated the projected number and distribution of populations within the species range relative to the current condition under two future scenarios (sections 3.2, Moderate Energy Development and 3.3, High Energy Development).

1.2.3. Representation

Species-level representation is the ability of a species to adapt to near and long-term changes in the environment, and it demonstrates the evolutionary capacity or flexibility of a species (Smith *et al.* 2018, p. 304). Representation is the range of variation found in a species, and this variation--called adaptive diversity--is the source of species' adaptive capabilities. Representation can be measured by the breadth of ecological and genetic diversity of the species. Ecological diversity is the physiological, ecological, and behavioral variation exhibited by a species across its range. Genetic diversity is the number and frequency of unique alleles (different forms of a gene) within and among populations. By maintaining these two sources of adaptive diversity across a species' range, the responsiveness and adaptability of a species over time is preserved.

We held an expert panel meeting on June 2, 2017, to review and discuss pertinent information regarding the range of ecological and genetic variation (representation) found in Graham's and White River beardtongues (USFWS 2017, p. 4). We used the information from the expert workshop to help us identify the appropriate scale and dataset to evaluate ecological variation (section 6.4, Species Representation). To assess Graham's and White River beardtongues' future representation, we evaluated the projected changes in demographic (population size) and ecological (ecological settings) factors, as surrogates for genetic diversity relative to the current condition (sections 3.2, Moderate Energy Development and 3.3, High Energy Development).

Chapter 2. Future Condition: Factors Influencing Viability

In this chapter, we summarized our future projections for stressors (external factors) and conservation efforts that may influence the viability of Graham's and White River beardtongues. The stressors are the same as those we evaluated in our recent Biological Report, and include three types of energy exploration and development (oil shale, tar sands, and traditional oil and gas drilling); road construction; herbivory; invasive weeds; small population size; and climate change. For each stressor, we included a quantitative assessment of the projected future magnitude of the stressor (where possible). For more detail on the stressors and their effects to the beardtongues, please refer to our Biological Report (USFWS 2020a, entire).

We begin by stating our assumptions and the future forecast of each stressor, followed by the future protections afforded to the beardtongues, including implementation of the conservation agreement (2014 CA) and regulatory mechanisms.

1.1 Oil Shale

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For oil shale, we considered past and current exploration and commercial development activities, expert opinion of likelihood estimates (section 1.2, Analytical Framework), and the best available information. Here, we summarize the likelihood estimates for future exploration and development, and our two future oil shale forecasts. For more detail about this stressor and future likelihood estimates, see Appendix 1.

<u>Exploration Activities</u>

Within the beardtongues' ranges, oil shale exploration activities are occurring on non-Federal lands in Utah, due to fewer restrictions on oil shale leasing and exploration activities (e.g. regulatory review), and lower costs of leasing, royalty rates (payment to landowner on fuel removed), and taxes as compared to Federal lands (Institute for Clean and Secure Energy (ICSE) 2013, pp. 5 – 6, 37 – 48, 51, 52; Industrial Economics, Incorporated (IEC) 2014, pp. 14 – 26; Utah Administration Code 2020, entire; BLM 2017, p.4; Ruple 2017, pp. 24 – 25). It is likely that oil shale exploration will occur on non-Federal lands beyond 2030 (Table 4; Ruple 2017, p. 32; USFWS 2019 and 2020a, entire; Utah Division of Oil Gas and Mining (UDOGM) 2019a, 2020a, 2020b, 2020c, entire;).

Commented [JS6]: "This oil shale exploration on non-Federal lands is likely to occur beyond 2030." – rephrased for more clarity

Table 4. Summary of future oil shale exploration and development in the range of the Graham's and White River beardtongues.

Oil Shale Activities	Landownership	Likelihood of the Outcome	
		2020 – 2030	2030+
Exploration	State and Private Lands (with high economic potential)[1]	Likely	Likely
	BLM Lands (with high economic potential)	Unlikely	Unlikely
Commercial Development	State and Private Lands (Seep Ridge, Holliday block, Enefit South Block)[2]	About as likely as not	Cannot make a reliable prediction
	BLM Lands (with high economic potential)	Unlikely	Cannot make a reliable prediction

Commented [JS7]: This footnote is confusing; "These lands are identified from Utah Geological Survey (UGS) shapefiles provided by Michael Vanden Berg identifying oil shale resource areas of 15 GPT at on the surface to a 400 foot (ft) depth for surface mining." Are you including resources that are least 15 GPT and can be found at depths up to 400 feet?

On Federal lands in Utah and Colorado, oil shale leasing has declined over time and there is currently one active research, development, and demonstration (RD&D) lease on 160 acres (ac) in Utah outside of beardtongue habitat (Ruple 2017, p. 24; USFWS 2019 and 2020a, entire). The BLM has not received proposals for new RD&D leases (USFWS 2019, p. 4), and it is unlikely that oil shale exploration will occur on Federal lands within the next 10 years due to the additional restrictions and regulations, and higher costs relative to non-Federal lands (Table 4; USFWS 2020b, entire; ICSE 2013, pp. 5 – 6, 40 – 48, 51, 52; IEC 2014, pp. 14 - 26). The likelihoods of future exploration may change if there are changes to Federal leasing requirements for oil shale.

Oil shale exploration activities have the potential to increase above current activity levels if the technology improves and the economic oil market becomes more favorable. Likewise, oil shale exploration activities have the potential to decrease below current activity levels if the market price of oil remains low. We anticipate exploration activities will occur on state and private lands at a low level that is similar to current levels of exploration activities, until the extraction technology improves and economic market conditions become more favorable (USFWS 2019, p. 4).

<u>Commercial Development Activities</u>

There is currently no commercial development of oil shale in the beardtongues' ranges despite the vast amount of the resource in the Uinta and Piceance Basins (Weiss *et al.* 1982, p. 1; ICSE 2011, p. 2; ICSE 2013, pp. 9, 23; IEC 2014, p. 14; Aho 2015, p. 334; BLM 2017, p. 14; Mills *et al.* 2019, p. 31). The oil shale resource in Utah and Colorado is thermally immature compared to

[1] These lands are identified from Utah Geological Survey (UGS) shapefiles provided by Michael Vanden Berg identifying oil shale resource areas of 15 GPT at on the surface to a 400 foot (ft) depth for surface mining.
[2] The predictions are only for the best areas for commercial development identified in parentheses.

other areas of the world (e.g. Estonia and Jordan) where oil shale mining is occurring (ICSE 2011, p. 2). Therefore, the current technologies employed for commercial development elsewhere are not directly applicable to oil shale in the Uinta and Piceance Basins, because the resource requires additional heat and processing, which adds considerable costs to production (ICSE 2011, p. 2; USFWS 2020b, entire).

The lack of an efficient extraction technology and low oil market values are the primary constraints for commercial development (BLM 2017, pp. 75 – 76). Oil shale industry representatives (e.g. Red Leaf Resources, Inc. and Enefit) are optimistic that efficient extraction technologies will be developed within the next ten years, and state the primary constraint for commercial development is the price of crude oil (USFWS 2020b, pp. 3 – 4). It is about as likely as not that oil shale commercial development will occur on state and private lands in the next ten years (Table 4; USFWS 2020b, entire). The best areas for commercial development within the beardtongues' ranges are state and private lands in three general areas including Seep Ridge area, Holliday block, and Enefit South Block, due to the size of the resource and the consolidated acreage of non-Federal lands. We are not able to provide a reliable prediction for oil shale commercial development beyond 2030, because experts considered the uncertainty to be too great beyond this timeframe (Table 4; BLM 2017, pp. 75 – 76; USFWS 2019 and 2020a, entire). This 10-year forecast period is consistent with an economic forecast of this industry and the considerable uncertainty of predicting beyond this timeframe (IEC 2014, p. 20).

On Federal lands in Utah and Colorado, the BLM has not developed a reasonably foreseeable development scenario because the information on oil shale is too speculative to permit future commercial leasing proposals (BLM 2013, pp. 24, 64). The BLM does not currently allow leasing for commercial development of oil shale, because the agency will need to consider the environmental consequences of future technology and proposed commercial projects before committing to broad scale commercial oil shale development (BLM 2013, pp. 27, A-4 – A-10; BLM 2017, pp. 5, 63 – 68). As such, we no longer consider Federal lands outside of current RD&D areas in Utah and Colorado as likely to be developed in the next ten years (78 FR 47599, August 6, 2013).

Future Forecasts for Oil Shale

We developed two future forecasts (a moderate and high forecast) indicating where surface disturbance may occur due to oil shale exploration and development within the beardtongues' ranges over our forecast timeframe for oil shale of 2020 to 2030. The moderate forecast assumed disturbance would occur on lands with the highest development potential for oil shale, and where exploration activities are in progress. The high forecast assumed disturbance will occur on the same lands as the moderate forecast, plus other non-Federal lands with high economic potential surface deposits (15 gallons per ton (GPT) threshold) and those under lease or permit for oil shale.

For both forecasts, we assumed that total loss of plants and habitat would occur within these disturbed areas, to evaluate the worst-case impacts from oil shale; and that commercial development activities will occur in the next ten years. We did not develop an "exploration-only" forecast, with a smaller surface disturbance area, even though it would also be a plausible

Commented [JS8]: I am not familiar with this concept of Utah and Colorado oil shales being more thermally immature than other oil shales. You did not get this idea from ICSE 2011, p. 2. This reference discusses the fact that the organic material in all oil shales (kerogen) is thermally immature compared with conventional oil. It is an oil precursor, so the rock must be heated to release the kerogen in the form of oil, natural gas and/or graphite. According to the Utah Geological Survey website, https://geology.utah.gov/map-pub/survey-notes/oil-shale-vs-shale-oil-whats-the-difference/, "Estonia and China produce significant amounts of oil from their oil-shale deposits that are organically richer than those in the Green River Formation; environmental regulations are also much less stringent in these countries."

Commented [JS9]: As with my previous comment, you are incorrectly interpreting the ICSE 2011 reference. The reference states that all oil shales require more heat/processing than conventional oil because kerogen is an immature form of oil.

future forecast for oil shale, but these smaller impacts would be expected to fall within the range between current conditions and our two future scenarios.

We removed 2014 CA designated conservation areas on Federal and state lands from our analysis of disturbance, because these areas are afforded protections until 2034, which exceeds our forecast timeframe for oil shale. We did not remove 2014 CA designated conservation areas on private lands from our analysis, because protections on those lands expire in 2029, during our forecast timeframe for oil shale. We summarized the moderate and high forecasts, below.

Commented [JS10]: How much land is this?

Oil Shale - Moderate Forecast

The moderate forecast identified disturbance from oil shale activities in the following areas (Figures 2 and 3):

- The best areas for commercial development on state and private (non-Federal) lands included the Seep Ridge, Holliday Block, and Enefit South Block areas (USFWS 2020b, entire). Exploration and commercial development are not expected to occur on Federal lands during our forecast timeframe.

The moderate forecast identified that the following areas would not be developed for oil shale:

- 2014 CA designated conservation areas on state lands.

The moderate forecast identified that the oil shale stressor overlaps with six Graham's beardtongue populations (13, 17, 18, 19, 20, 22) and three White River beardtongue populations (8, 9, 10).

Oil Shale - High Forecast

The high future forecast identified disturbance from oil shale activities in the following areas (Figures 4 and 5):

- The best areas for commercial development on state and private (non-Federal) lands included the Seep Ridge, Holliday Block, and Enefit South Block areas (USFWS 2020b, entire). Commercial development is not likely to occur on Federal lands.
- All lands (Federal and non-Federal) currently under lease or permit for oil shale.
- State and private (non-Federal) lands with high economic potential (15 GPT) for surface and underground mining as identified by Utah Geological Survey (UGS) shapefiles (USFWS 2020b, entire).

The high future forecast identified that the following areas would not be developed for oil shale:

- 2014 CA designated conservation areas on Federal and state lands.
- Federal lands subject to the following resource management plan (RMP) restrictions: 300 ft avoidance buffer; the slope (40 degrees or greater) stipulation, the NSO stipulation, and the Area of Critical Environmental Concern (ACEC) designation (section 1.9, Future Protections Afforded to the Beardtongues).

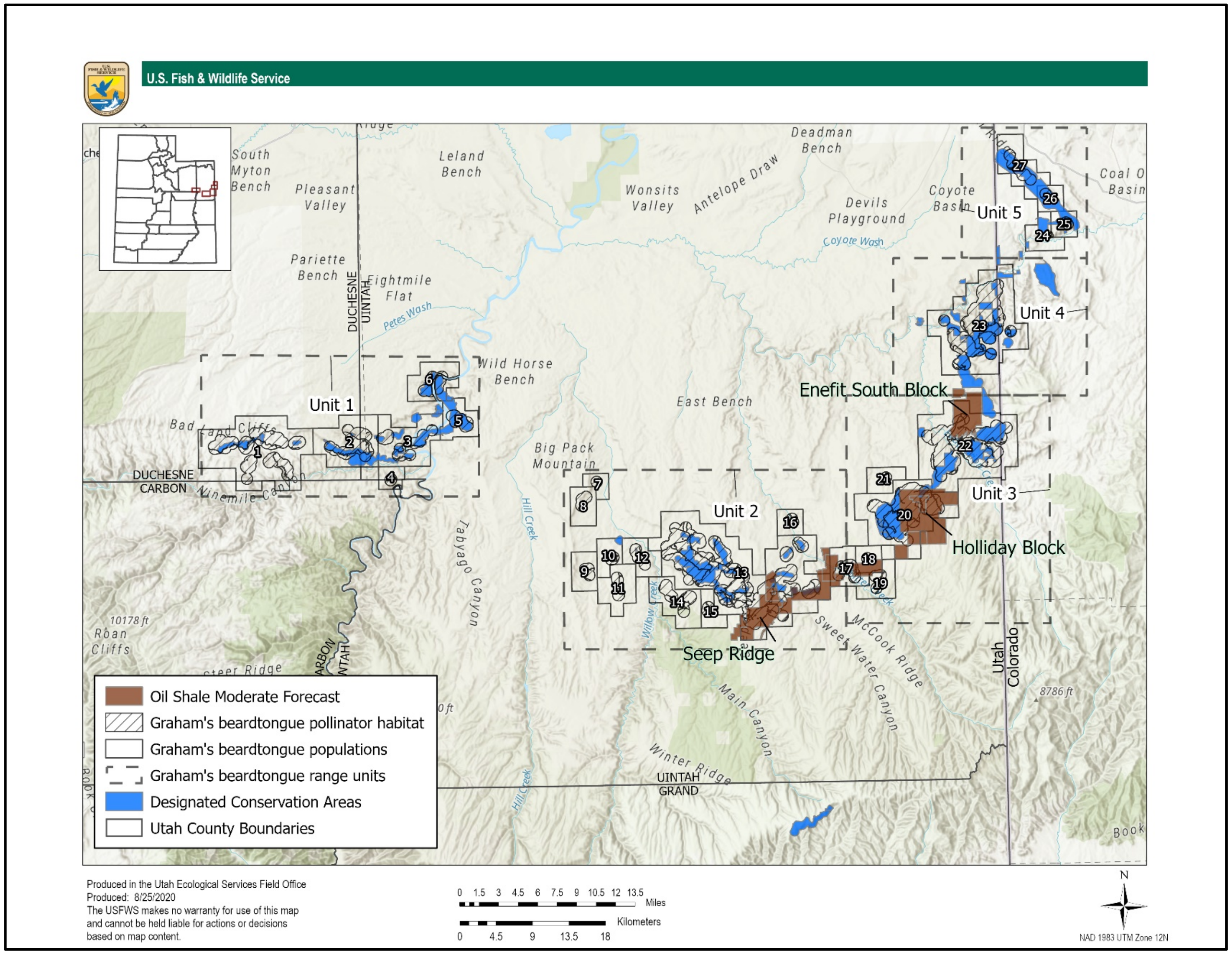

Figure 2. The moderate forecast for oil shale and Graham's beardtongue populations 1 - 27.

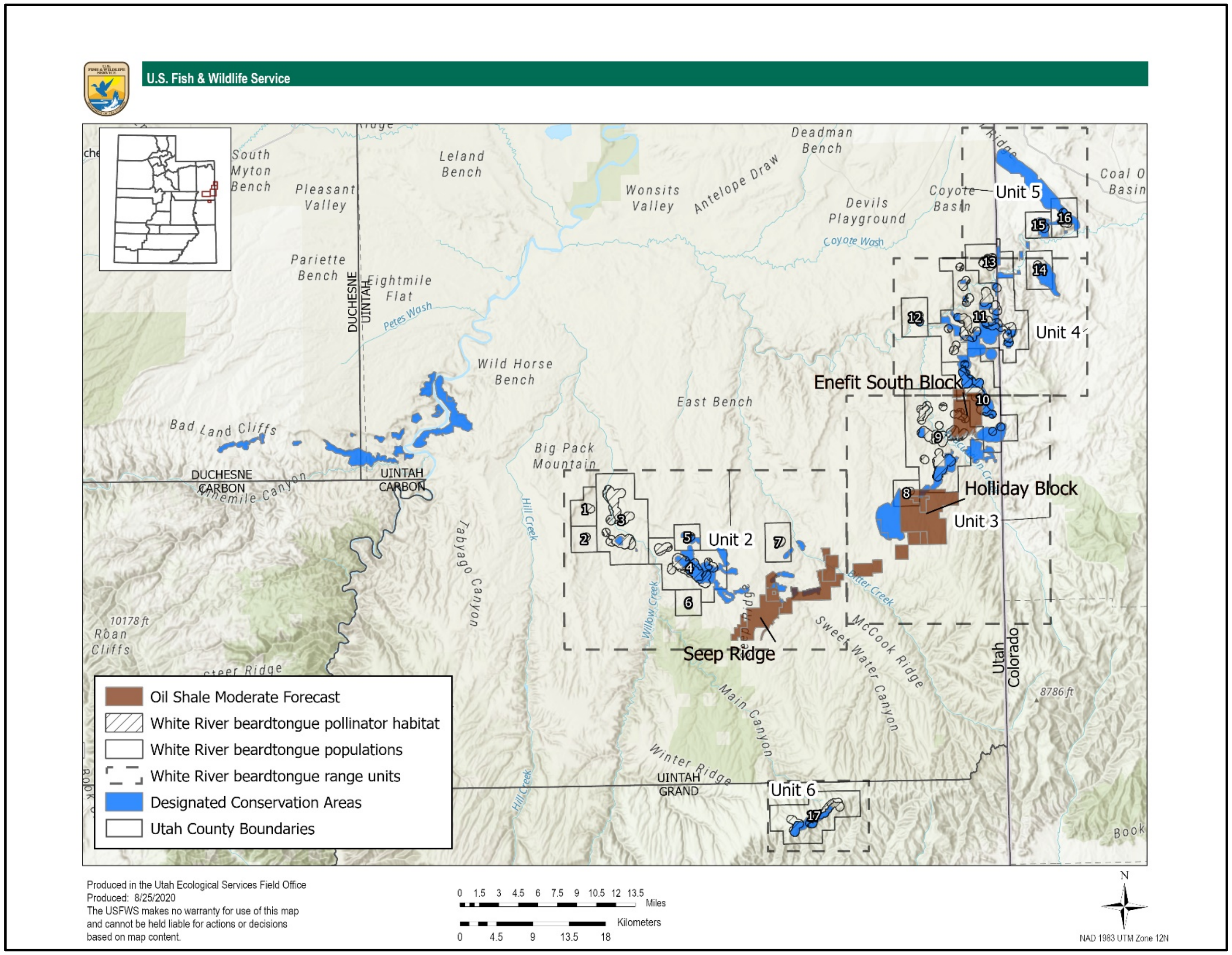

Figure 3. The moderate forecast for oil shale and White River beardtongue populations 1 - 17.

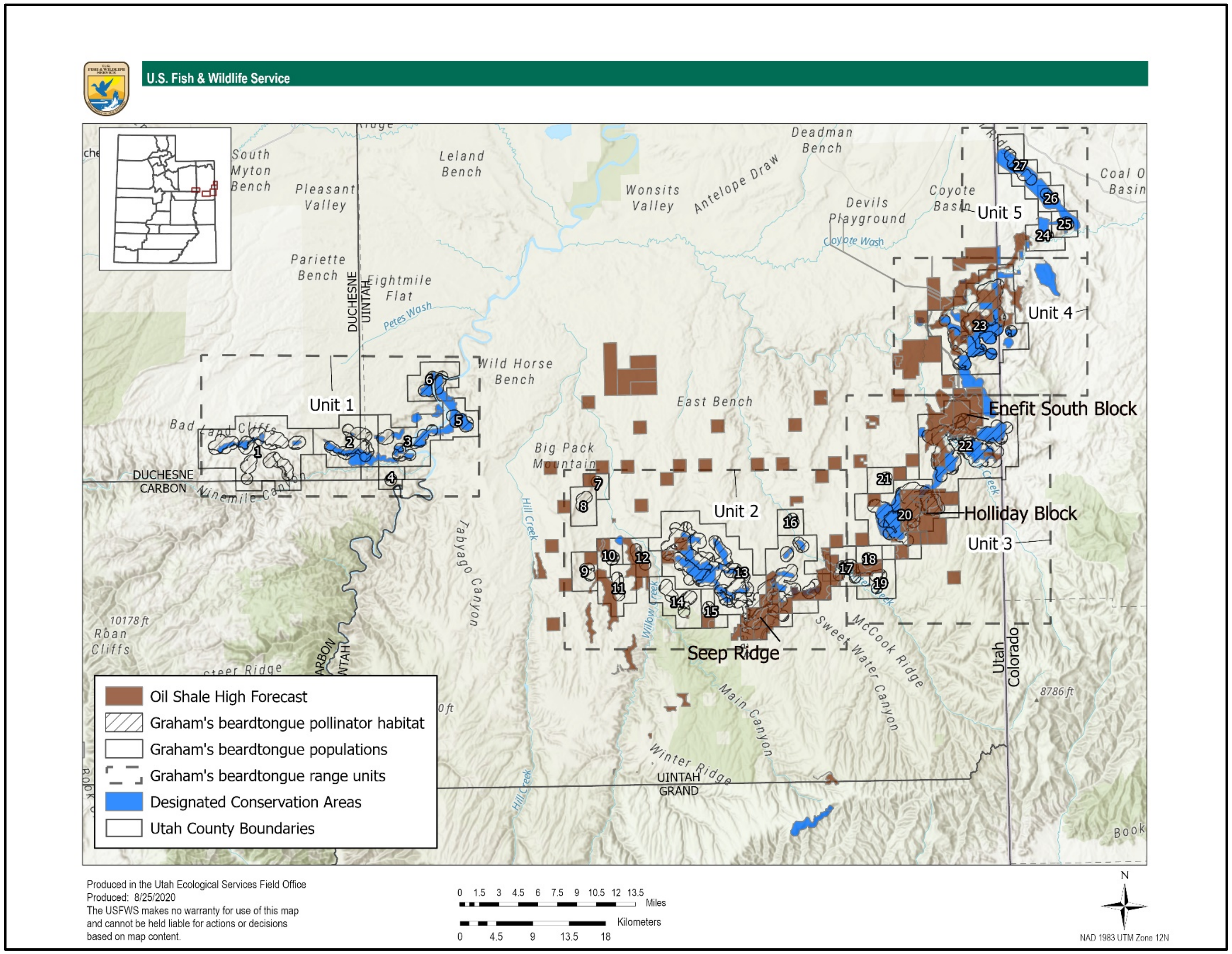

Figure 4. The high forecast for oil shale and Graham's beardtongue populations 1 - 27.

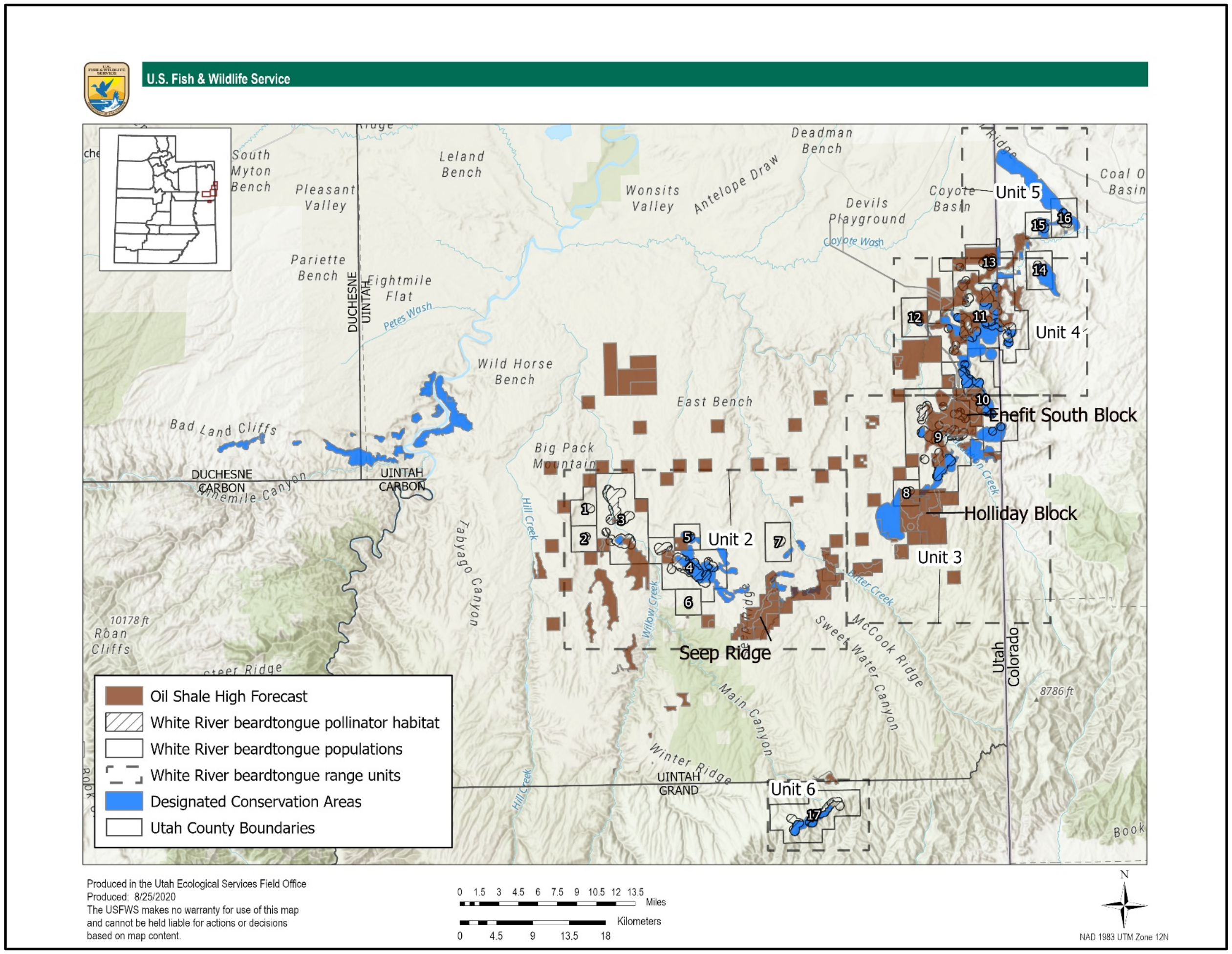

Figure 5. The high forecast for oil shale and White River beardtongue populations 1 – 17.

The high forecast identified that the oil shale stressor overlaps with 11 Graham's beardtongue populations (7, 11, 12, 13, 15, 17, 18, 19, 20, 22, 23) and 8 White River beardtongue populations (4, 5, 8, 9, 10, 11, 12, 13).

<u>Uncertainty</u>

Using best available information, there is too much uncertainty for us to project the following:

- Specific locations or an estimated number of future RD&D leases on Federal lands.
- The timing and type of oil shale extraction technology that will be developed in the future.
- If there will be future technology that results in commercially viable oil shale development in the Uinta Basin.
- The timing of favorable economic oil markets that would result in economically viable commercial oil shale development in the Uinta Basin.
- A certain rate of exploration or disturbance within the identified area over time unless there are approved mining plans.

There are large uncertainties involved in predicting profitability for commercial oil shale development due to the difficulty of:

- Estimating the threshold or "hurdle price" of crude oil needed to motivate investment for the construction of commercial-scale oil shale facilities, given the high capital costs. The threshold would probably be substantially higher than the crude oil market price (Bartis *et al.* 2005, p. 46; ICSE 2013, pp. 134 – 135; Spinti *et al.* 2013, pp. 14 – 17).
- Predicting future crude oil prices due to their high annual volatility (variability) (Bartis *et al.* 2005, pp. 45 – 46; ICSE 2013, pp. 90 – 91; BLM 2017, p. 76).
- Evaluating the Red Leaf Resources, Inc. oil product to predict profitability (IEC 2014, pp. 23 – 24).

1.2 Tar Sands

For tar sands, we considered past and current exploration and commercial development activities, expert opinion of likelihood estimates (section 1.2, Analytical Framework), and the best available information. Here, we summarize the likelihood estimates for future exploration and development, and our future tar sands development forecast.

<u>Exploration Activities</u>

Within the beardtongues' ranges, the only past and current tar sands exploration area is the PR Spring Mine on state and private lands in the PR Springs South area next to one White River beardtongue population (17) in the Book Cliffs (Figure 6; USFWS 2020a, pp. 48 – 49). Recent exploration activities focused on surface mining techniques on tar sands deposits to a depth of 500 ft below the surface (Boden *et al.* 2018, p. 25; UDOGM 2019b, p. 3; UDOGM 2019c, entire). It is likely that tar sands exploration will continue on state and private lands in the PR

Springs Special Tar Sands Area (STSA) South area based on exploration results and the pattern of testing new technologies on the tar sands surface deposits at this location (Table 5; Blackett 1996, p. 1; ICSE 2013, pp. 5 – 6, 26; USFWS 2020b, entire). Exploration in the northern part of the PR Springs STSA (PR Springs North) is unlikely in the next 10 years due to the lower quality and quantity of the surface deposits (Table 5; USFWS 2020b, entire).

Table 5. Summary of future tar sands exploration and development in the range of the Graham's and White River beardtongues.

Tar Sands Activities	Landownership	Likelihood of the Outcome	
		2020 – 2030	2030+
Exploration	State and Private Lands (Asphalt Ridge, PR Springs South)[3]	Likely	Likely
	State and Private Lands (PR Springs North) [4]	Unlikely	Unlikely
	BLM Lands (outside of active lease areas)	Unlikely	Unlikely
Commercial Development	State and Private Lands (Asphalt Ridge, PR Springs South)[5].	About as likely as not	Cannot make a reliable prediction
	BLM Lands (outside of active lease areas)	Unlikely	Cannot make a reliable prediction

In the PR Springs STSA, the BLM issued combined hydrocarbon leases that allow for tar sands exploration and traditional oil and gas development in the 1980s and 1990s, and had pending conversion applications under review since the 1980s (BLM 1985, entire; BLM 2013, pp. 37 – 40). Locations of proposed lease conversions were predominantly in the PR Springs South area (BLM 1985, p. A-4, A-11). There is only one lease conversion application in process by Enercor that was recently finalized in the PR Springs South area, outside of beardtongue-occupied and pollinator habitat (Nordstrom 2020, entire).

Tar sands exploration activities have the potential to increase above current levels if the technology improves and the economic oil market becomes more favorable. Likewise, tar sands exploration activities have the potential to maintain their current status of no activity if the market price of oil remains low. We anticipate exploration activities will occur on state and private lands at a low level that is similar to recent exploration activities until the extraction technology improves, and economic market conditions become more favorable (Table 5; USFWS 2020b, entire). We expect future exploration activities to continue within current lease areas in the PR Springs South area (Boden *et al.* 2018, p. 25; Mills *et al.* 2019, p. 32; USFWS 2020a, entire; USFWS 2020a, pp. 48 – 49).

[3] See USFWS 2020b, p. 14.
[4] See USFWS 2020b, p. 14.
[5] The predictions are only for the best areas for commercial development identified in parentheses.

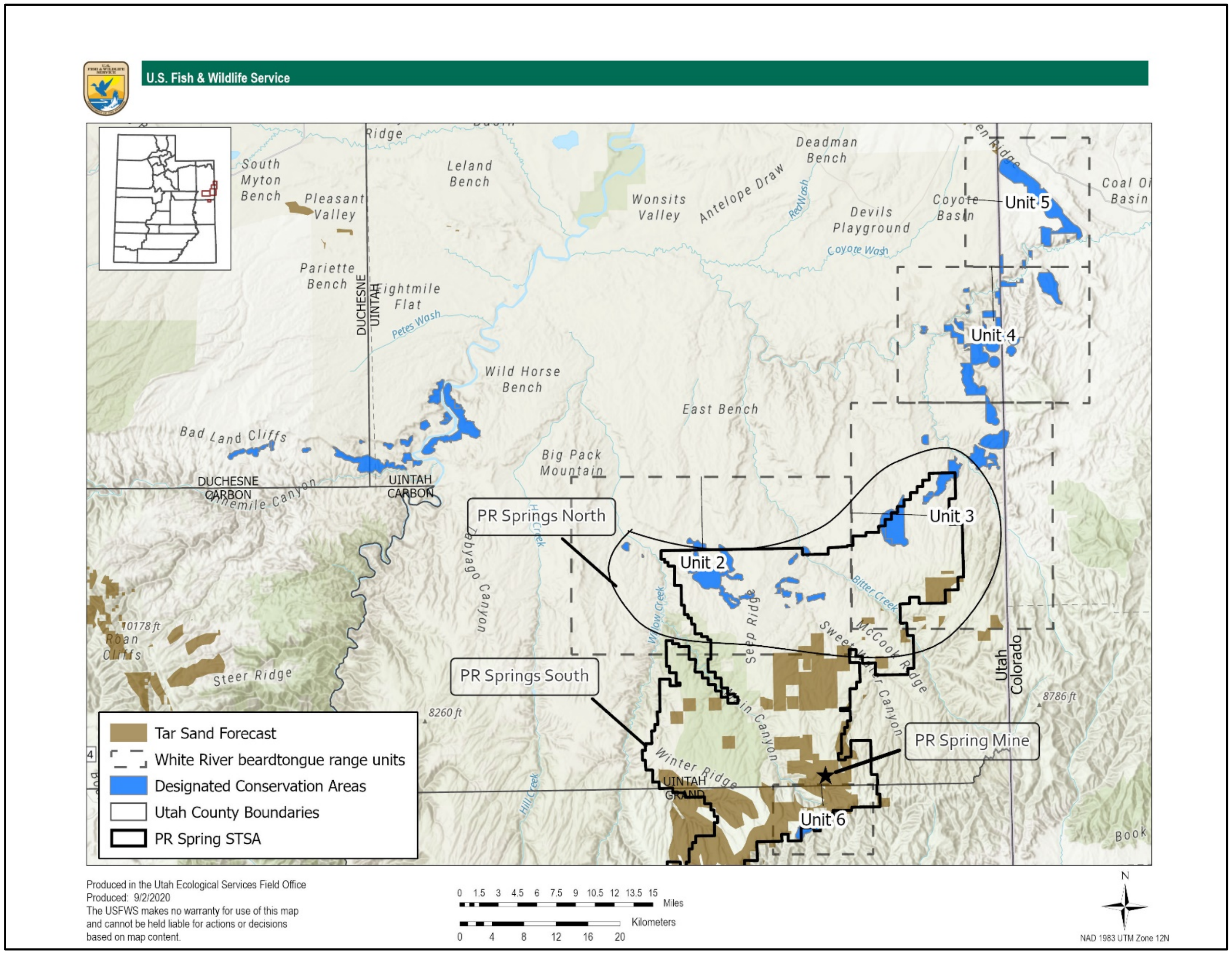

Figure 6. The PR Springs North and South areas and the PR Springs Mine in the PR Springs Special Tar Sand Area (STSA).

Commented [JS11]: The PR Springs North and South delineation is unclear. Is the PR North boundary everything inside the random line drawn on the plot? Could you make the boundaries different colors for clarity?

Commercial Development Activities

There is currently no commercial development of tar sands in the Uinta Basin and the beardtongues' ranges, despite the vast amount of the resource in the Uinta Basin special tar sands areas (STSAs) (Dana and Sinks 1984, p. 220; Blackett 1996, p. 1; BLM 2013, pp. 37 – 40; ICSE 2013, pp. 26 – 30, 230; Boden *et al.* 2018, p. 25; Mills *et al.* 2019, p. 32). The tar sands resource in Utah is considered low grade and occurs in thin layers that would require considerable operating expenses to remove overburden, process, and transport, in addition to transportation and water availability constraints (ICSE 2013, pp. 26 – 30). The current technologies employed for commercial development in Alberta, Canada are not directly applicable to oil shale in the Uinta Basin, and future commercial development, if any, would likely be much smaller in size than Alberta, Canada (ICSE 2013, pp. 26 – 30).

Tar sand industry representatives are optimistic that efficient extraction technologies will be developed in the next ten years, and state the primary constraint for commercial development is the price of crude oil (USFWS 2020b, pp. 3 – 4). The best areas for commercial development are state and private lands in the PR Springs South area (USFWS 2020b, p. 14). We are not able to provide a reliable projection for tar sand commercial development beyond 2030 because experts considered the uncertainty to be too great beyond this timeframe, such that projections would become speculative (Table 5; USFWS 2020b, entire). The 10-year forecast period is consistent with an economic forecast of this industry and the considerable uncertainty of predicting beyond this timeframe (IEC 2014, p. 20).

On Federal lands in Utah and Colorado, the BLM has not developed a reasonably foreseeable development scenario because the information on commercial development of tar sands is too speculative to evaluate potential impacts of future development (BLM 2013, pp. 63 – 64). The BLM allows leasing for commercial development of tar sands and will need to consider the environmental consequences of future technology and proposed commercial projects within STSAs (BLM 2013, pp. 27, A-4 – A-10; BLM 2017, pp. 5, 63 – 68). Based on our review of best available information, we no longer consider any of the Federal lands identified as available for tar sands leasing in Utah and Colorado likely to be developed in the near future (78 FR 47599, August 6, 2013). It is unlikely that tar sands commercial development will occur on Federal lands in the next ten years (Table 5; USFWS 2020b, entire). We are not able to provide a reliable prediction beyond 2030 because experts considered the uncertainty to be too great beyond this timeframe (Table 5; BLM 2017, pp. 75 – 76; USFWS 2019, entire; USFWS 2020b, entire).

Future Forecast for Tar Sands

We identified one future forecast for tar sands exploration and development where surface disturbance may occur within the beardtongues' ranges over our forecast timeframe for the stressor (2020 – 2030). The forecast included lands under lease or permit for tar sands. Our analysis included the following assumptions: commercial development activities for tar sands will occur in the next 10 years; and the total loss of plants and habitat will occur where disturbance due to tar sands is projected, to evaluate worst-case impacts from this stressor. We did not develop an exploration only forecast with a smaller surface disturbance extent even though it would also be a plausible future forecast for tar sands. Therefore, our scenario is intended to bracket the full range of plausible future impacts, and the actual future impacts of tar sands to the beardtongues may fall anywhere in between their current conditions and the impacts projected in our forecast.

We removed 2014 CA designated conservation areas on Federal and state lands from our future analysis of tar sands impacts, because these areas are afforded protections until 2034, which exceeds our forecast timeframe for tar sands. We did not remove 2014 CA designated conservation areas on private lands from our analysis, because protections expire in 2029, during our forecast timeframe. We summarized the forecast, below.

The tar sands forecast assumed disturbance from tar sands activities would occur in the following areas (Figure 6; Figure 7):

- All lands currently under lease or permit for tar sands.
- State and private (non-Federal) lands with tar sands surface deposits in the PR Springs South area (Book Cliffs).

We also identified that the following areas would not be developed for tar sands:

- 2014 CA conservation areas on Federal and state lands.

The forecast identifies that the tar sands stressor overlaps with one White River beardtongue population (17) (Figure 7), but no Graham's beardtongue populations (Figure 6).

<u>Uncertainty</u>

Using the best available information, there is too much uncertainty for us to predict the following conditions:

- The timing and type of tar sand extraction technology developed in the future.
- If there will be future technology that results in commercially viable tar sand development in the PR Springs STSA.
- The timing of favorable economic oil markets that would result in economically viable commercial tar sand development in the PR Springs STSA and other STSAs in the Uinta Basin.
- A certain rate of exploration or disturbance within the identified area over time unless there are approved mining plans.

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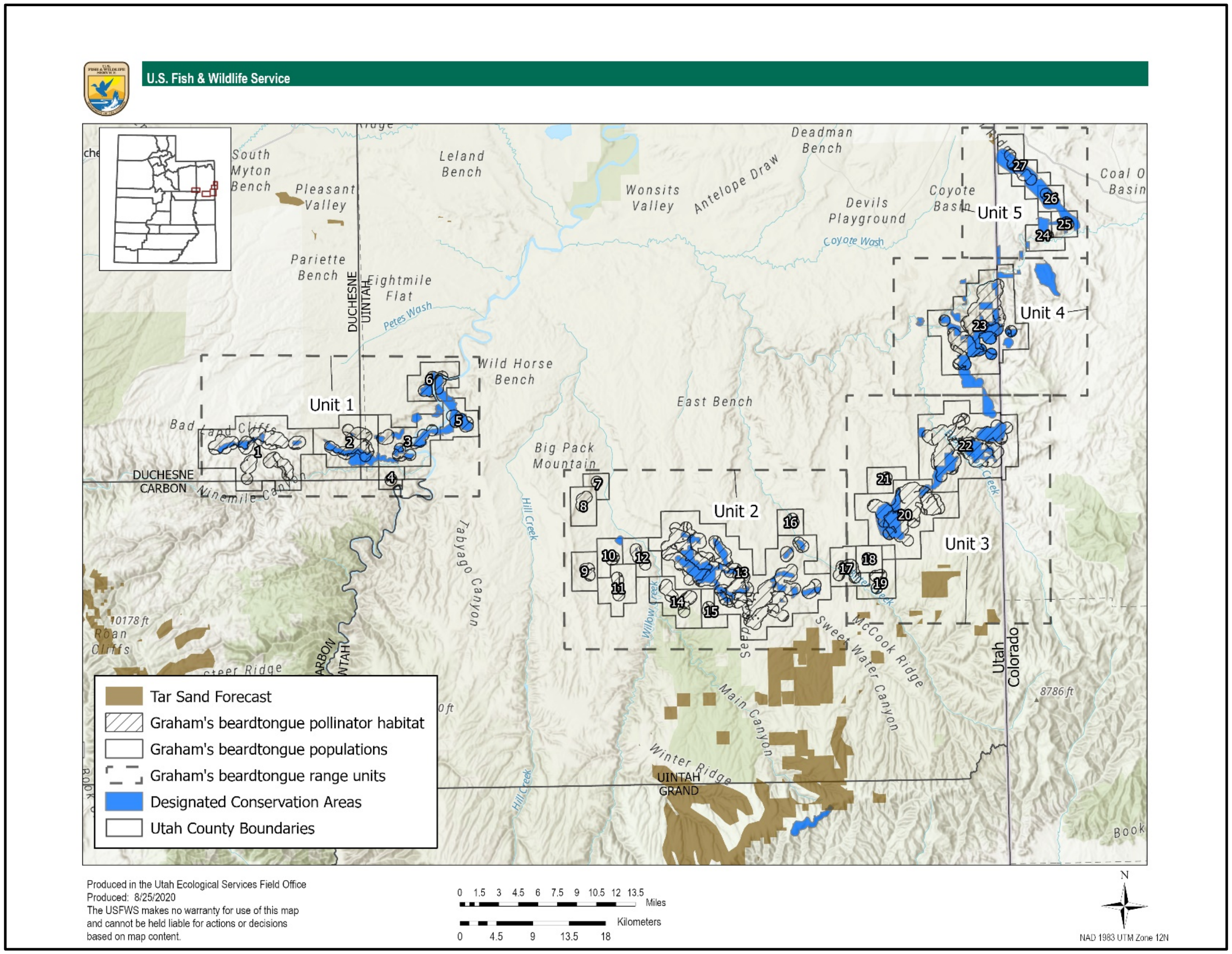

Figure 7. The forecast for tar sands and Graham's beardtongue populations 1 -27.

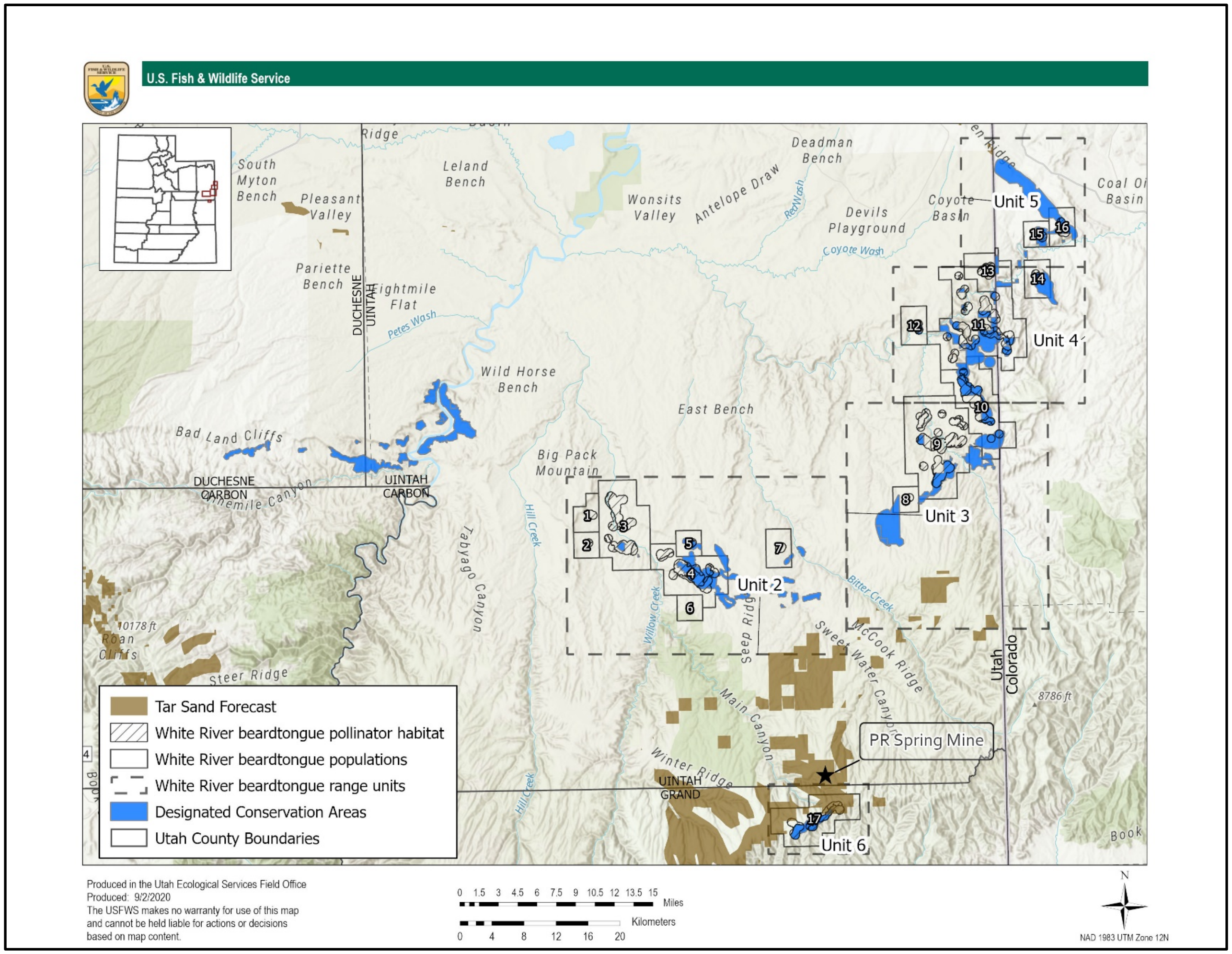

Figure 8. The forecast for tar sands and White River beardtongue populations 1 - 17.

There are large uncertainties involved in predicting profitability for commercial tar sand development due to the difficulty of:

- Estimating the costs associated with utilities, infrastructure, and site-specific extraction methods, recovery and upgrading due to the variable composition of the tar sand resource (Oblad *et al.* 1987, pp.330, 346 – 347; ISCE 2013, pp. 216 – 217, 220 – 230). Tar sands commercial development was predicted to be profitable only with a high-quality resource deposit similar to the Asphalt Ridge STSA located outside of the beardtongues' ranges (ICSE 2013, p. 228; Spinti *et al.* 2013, pp. 14 – 17).
- Comparing capital and supply costs of different project operations (ISCE 2013, pp. 228 – 230).

1.3 Traditional Oil and Gas

For evaluation of traditional oil and gas, we considered past and current exploration and commercial development activities, expert opinion of likelihood estimates (section 1.2, Analytical Framework), and the best available information. Here, we summarize the likelihood estimates for future exploration and development, and our future oil and gas forecast.

Exploration Activities

The oil resource within the beardtongues' ranges has been explored to a limited extent in two of the six range units (1 and 2), whereas the majority of past oil exploration has occurred north of their ranges to delineate known oil fields. Based on past exploration efforts, there is one delineated oil field in range unit 2 that overlaps with four Graham's beardtongue populations (9, 10, 11, 12) and two White River beardtongue populations (2, 3), and it occurs primarily on private and state lands. Interest in future oil exploration is low within the beardtongues' ranges because companies are focusing on commercial development within delineated oil fields north of the species' ranges. There is some interest in exploring the Mancos B play (a sandy interval within the Mancos Shale, also referred to as the Prairie Canyon member of the Mancos Shale in the literature) on the Utah – Colorado border, to assess its production potential (Vanden Berg 2018, p. 2; Wiseman and Birgenheier 2019, entire; USFWS 2020b, entire). It is likely that 5 to 10 wildcat wells[6] will be drilled over the next 5 to 10 years in Uintah County to explore the oil resource of the Mancos B play; drilling locations within the county have not been determined (USFWS 2020b, entire). This would be equivalent to 30 acres of disturbance (assuming 3 acres per well pad and associated infrastructure) somewhere in the county with the potential to overlap 10 Graham's beardtongue populations (1, 9, 10, 11, 12, 13, 15, 16, 21, 22) and one White River beardtongue populations (17) (USFWS 2020a, pp. 47 – 52; Moore 2019, entire). We are not able to provide a reliable prediction of oil exploration activities beyond 2030, because future likelihoods will be dependent upon the results of the Mancos B play production potential from the 5 to 10 wildcat wells (Table 6; USFWS 2020b, entire).

Commented [JS12]: Rewrite as "whereas the majority of past oil exploration to delineate known oil fields has occurred north of their ranges."

[6] Wildcat wells are drilled in areas that have not been explored and are considered unproven (Market Business News 2020, entire). These wells are expensive to drill and are considered a high risk venture (Market Business News 2020, entire).

Table 6. Summary of future oil and natural gas exploration and development in the range of Graham's and White River beardtongues.

Exploration Activities	Landownership	Likelihood of the Outcome	
		2020 – 2030	2030+
Oil	BLM, State and Private Lands (within Mancos B play)	Likely (5- 10 wells drilled)	Cannot make a reliable prediction
Natural Gas	BLM, State and Private Lands	None – Exploration Complete	
Commercial Development Activities	**Landownership**	**Likelihood of the Outcome**	
		2020 – 2030	**2020 – 2030**
Oil	BLM, State and Private Lands	Unlikely[7]	Cannot make a reliable prediction
Natural Gas	BLM, State and Private Lands	Likely[8] (0-5 wells drilled per year)	Cannot make a reliable prediction

The natural gas resource within the beardtongues' ranges has already been explored and there is no need or interest to perform exploration in the future (Table 6; USFWS 2020b, entire). Based on past exploration efforts, the natural gas resource is present across the beardtongues' ranges, inside and outside of delineated natural gas fields in Uintah County, and we discuss this further in the commercial development section, below.

Commercial Development Activities

We evaluated commercial development activity within the beardtongues' ranges based on publicly available oil and gas well information (Lewinsohn 2020, entire). Within the beardtongues' ranges, existing wells produce natural gas and oil, but most of them are not active and they are plugged and abandoned (Lewinsohn 2020, entire). Within beardtongue pollinator habitat, there are three Graham's beardtongue populations (1, 13, 22) and no White River beardtongue populations with active wells (e.g. producing wells, shut in wells[9], new applications).

Future oil commercial development is unlikely within the beardtongues' ranges over the next 10 years, because companies are focusing their development activities within delineated oil fields north of their ranges (Vanden Berg 2018, entire; Table 6). Therefore, we assume for our analysis

[7] We base this on the anticipated low level of exploration during this time period. We cannot make a reliable prediction of commercial development in the Mancos B play until exploration activities are complete.
[8] The likelihood is based on the U.S. Energy Information Administration (EIA) projections of natural gas prices from 2019 to 2030 (US EIA 2020a)
[9] Wells that are not producing enough of the resource to be profitable or are not producing due to low market prices (Holland and Hart 2015, entire).

that no new oil wells[10] will be drilled within the beardtongues' ranges over the next 10 years. We use a ten year forecast time period for the purpose of our analysis, but investment decision makers and policymakers generally use a 6 to 7 year time period for long-term forecasts (Alquist *et al.* 2011, pp. 30 – 32). Due to the unreliability of longer-term forecasts, we are not able to provide a reliable prediction beyond 2030. Future oil development likelihoods after 2030 will be dependent upon the exploration results of the Mancos B play production potential (Table 6; section 1.4 Traditional Oil and Gas, Exploration Activities; USFWS 2020b, entire).

Future natural gas commercial development within the beardtongues' ranges depends upon the market price of natural gas (Vanden Berg 2018, entire; USFWS 2020b, entire). Since forecasts of the natural gas price over the next 10 years are predicted to remain low, it is likely that 0 to 5 new natural gas wells will be drilled every year over the next ten years within the beardtongues' ranges (Table 6; McKinsey and Company 2019, entire; World Bank, 2019, p. 1; U.S. U.S. Energy Information Administration (EIA) 2020b, entire; U.S. EIA 2020c, pp. 3 – 4; USFWS 2020b, entire). The most likely area for future commercial development in Uintah County would be to expand the existing Greater Natural Buttes natural gas field in all directions, although this natural gas field is north of the beardtongues' ranges (Chidsey, Jr. 2011, entire; Vanden Berg 2018, p. 3; USFWS 2020b, entire).

For the purposes of our analysis, the most likely areas for future commercial development are in delineated oil and gas fields in the beardtongues' ranges. Delineated fields have not reached full field development and afford some infrastructure to reduce costs to the operator. A reasonable upper bound estimate of disturbance would be 50 natural gas wells over the next 10 years, an area equivalent to 150 acres of disturbance (assuming 3 acres per well pad and associated infrastructure (USFWS 2020b, entire). We expect flexibility in locating the well pad disturbance areas due to the increased use of horizontal and directional drilling methods to avoid or minimize loss of beardtongue plants and adhere to the 300 ft avoidance buffer restriction on BLM lands and 2014 CA conservation areas (Allis and Vanden Berg 2018, entire). We used a ten year forecast time period for the purpose of our analysis, which is generally consistent with some long-term forecasts for natural gas commercial development (McKinsey and Company 2019, entire; World Bank, 2019, p. 1). Due to the unreliability of long-term forecasts, we were not able to provide a reliable prediction beyond 2030, and future development likelihoods will be dependent upon the price of natural gas (Table 6; U.S. EIA 2020c, p. 3; USFWS 2020b, entire).

<u>Future Forecast for Oil and Gas</u>

We identified one future forecast for oil and gas exploration and development to project where surface disturbance may occur within the beardtongues' ranges over our forecast timeframe for the stressor (2020 to 2030). The forecast assumed additional drilling, well pads, and infrastructure will occur within delineated oil and gas fields. We evaluated each population on a case by case basis, and our analysis included the following assumptions: the loss of plants and habitat will occur where there is disturbance due to oil and gas on non-Federal lands; and avoidance of plants by 300 ft will occur with some loss of pollinator habitat on Federal lands.

[10] This is based on the well type defined in the application and permit approval, see Utah AGRC, 2020, entire for the summary of well types.

We included 2014 CA designated conservation areas on Federal and state lands in our analysis because these areas allow some development until the surface disturbance caps are met. These caps specify that a maximum of 5 percent new surface disturbance for Graham's beardtongue and 2.5 percent for White River beardtongue will be allowed per landownership with each range unit (Penstemon Conservation Team 2014, pp. 23 – 24). We considered 2014 CA designated conservation areas on private lands to be similar to other non-Federal lands in terms of availability for development, because protections expire in 2029, during our forecast timeframe. We summarized the forecast, below.

The traditional oil and gas forecast assumed disturbance from oil and gas activities would occur in the following areas (Figure 8; Figure 9):

- Oil exploration activities that result in ten wildcat well locations, each with 3 acres of disturbance, somewhere in Uintah County to explore the Mancos B play.
- Development in Uintah County in existing oil and gas fields.
- Potential disturbance in 2014 CA conservation areas as allowed by surface disturbance caps.

The traditional oil and gas forecast identified that the following areas would not be developed:

- Federal lands subject to the following RMP restrictions: 300 ft avoidance buffer; the slope (40 degrees or greater) stipulation, the NSO stipulation, and the ACEC designation (section 1.9, Future Protections Afforded to the Beardtongues).

The forecast identifies the traditional oil and gas stressor overlapping with 10 Graham's beardtongue populations (1, 9, 10, 11, 12, 13, 15, 16, 21, 23) and one White River beardtongue population (17).

Uncertainty

Using best available information, there is too much uncertainty for us to predict the following:

- The specific location of wildcat wells within Uintah County for oil exploration of the Mancos B play.
- If there will be future oil commercial development in the beardtongues' ranges. This will depend on the results of the Mancos B play oil exploration.
- A certain rate of commercial development within the identified area over time unless there are approved drilling plans.
- Locations of all new wells within the beardtongues' ranges outside of delineated oil and gas fields. New wells are not expected to be associated with an approved plan of development for full field development (e.g. concentrated wells and pad locations) but rather by individual lease-holders to drill a few additional well pads within their lease area.

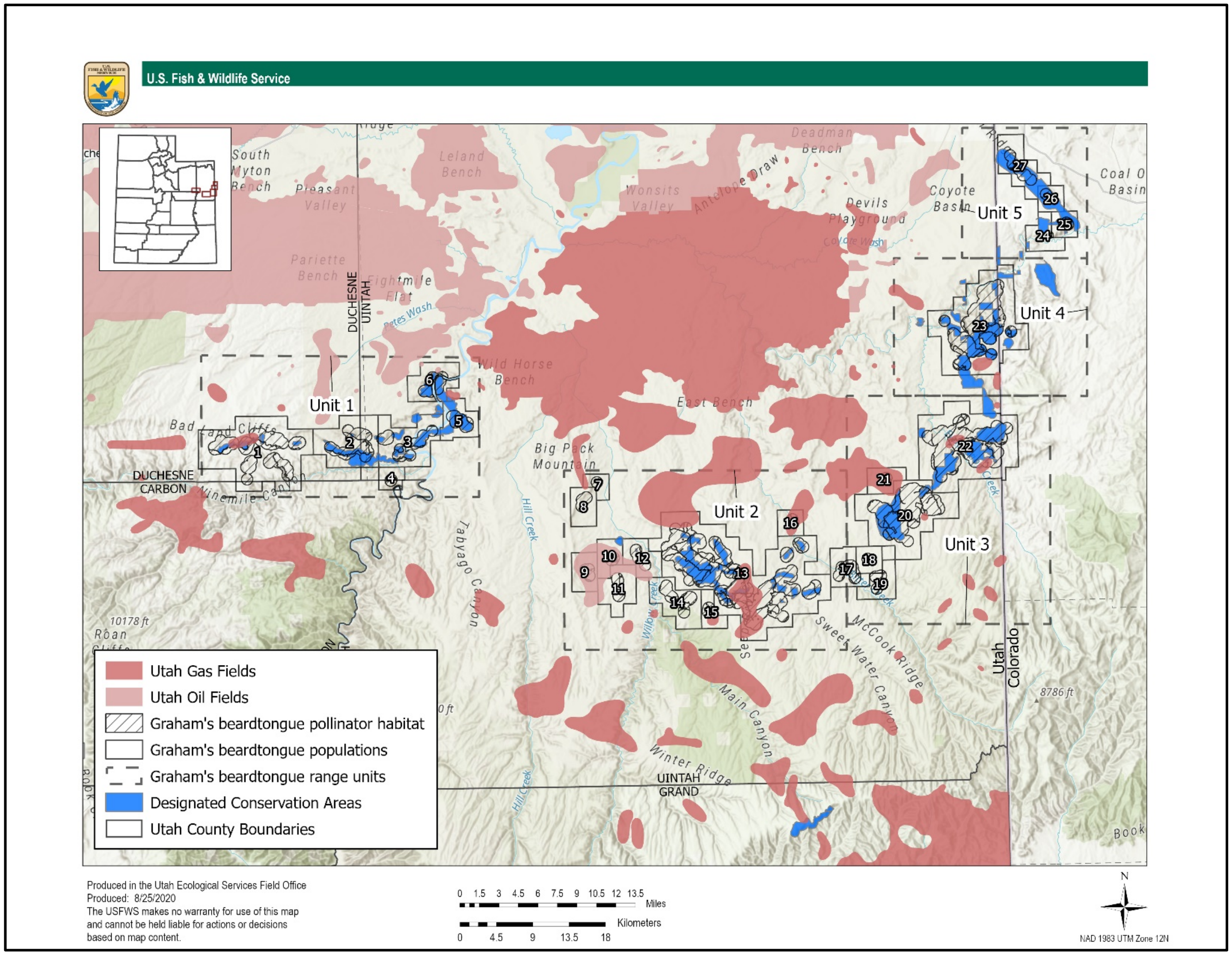

Figure 9. The oil and gas forecast and Graham's beardtongue populations 1- 27.

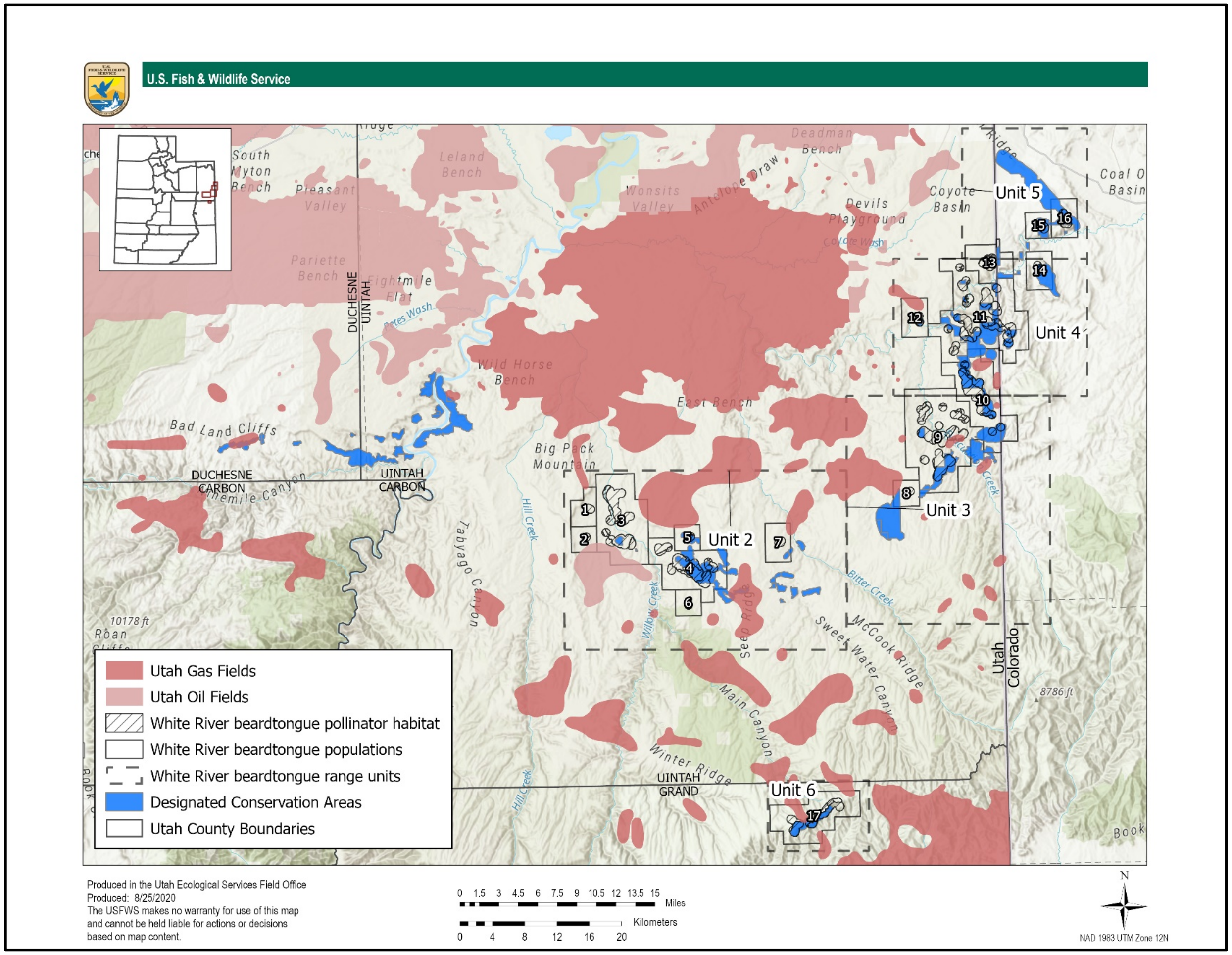

Figure 10. The oil and gas forecast and White River beardtongue populations 1 - 17.

1.4 Road Construction and Maintenance

Road construction and maintenance activities occur on private, state, and BLM lands within Graham's and White River beardtongues pollinator habitat. Many unpaved county roads cross through Graham's and White River beardtongue pollinator habitat, and most of these roads have existed for decades. Existing roads have resulted in small and localized impacts to Graham's and White River beardtongues (USFWS 2020a, p. 52). Road construction and paving projects occur infrequently, and we are not aware of other road construction or maintenance projects that are proposed to occur in areas where they would impact Graham's beardtongue or White River beardtongue (Baldwin 2019, entire; Federal Highway Administration (FHWA) 2020, entire; UDOT 2020, entire).

Any future road projects in the beardtongues' ranges would likely be upgrades and widening of existing roads, or new secondary or spur roads associated with energy development (Civco Engineering Inc. 2010, entire). Therefore, we did not perform a separate analysis of this stressor but rather included the effects of this stressor (habitat loss, habitat fragmentation, dust, weeds) as part of our analysis of energy development (oil shale, tar sands, traditional oil and gas).

1.5 Herbivory

Herbivory from native grazers and livestock occurs on a regular basis at a level that the beardtongues are able to withstand, based on population trend monitoring (USFWS 2020a, pp. 52 – 54). Occasionally, heavy sheep grazing results in more severe, localized impacts to the beardtongues which may take years to recover from (Penstemon Conservation Team 2015, entire; USFWS 2020a, pp. 52 – 54). We have no information that this pattern and impact of herbivory will change in the future. We expect herbivory to continue to exert localized impacts but not population-level impacts to beardtongue populations that are not affected by direct habitat loss from development.

For beardtongue populations that experience habitat loss as a result of development, changes in herbivory would be site-specific and allotment-specific. The effects of herbivory from native grazers and livestock may increase where available forage is reduced as a result of energy development. In some areas, this may result in more severe localized impacts to beardtongue individuals than current and past impacts. However, land managers can adjust stocking rates based on the amount of available forage, and native grazer populations will likely adjust to available forage and habitat. There is too much uncertainty for us to project future herbivory impacts within specific populations given best available data. To accurately project these impacts, we would need additional information at a site-specific level within beardtongue populations about current herbivores; their patterns and impacts to beardtongue individuals; available forage and grazing patterns; and future grazing management actions.

As part of the 2014 CA, the BLM committed to monitor livestock grazing in beardtongue populations and take corrective actions to reduce impacts, as necessary (section 1.9, Future Protections Afforded to the Beardtongues). Therefore, we expect future herbivory impacts would be addressed by land management actions and would not increase in beardtongues' populations on BLM lands. There is no commitment to take corrective actions within beardtongue populations affected by development on non-Federal lands if future herbivory impacts increase. Therefore, we identified the beardtongues' populations on non-Federal lands as populations where herbivory impacts may increase, as a result of habitat loss from energy development (section 3.1, Development of Future Scenarios).

Overall, herbivory is not a primary driver of the beardtongues' future condition. We have no information to indicate that future herbivory impacts would result in a population-level impact to the beardtongues. There is the potential for herbivory impacts to increase in populations on non-Federal lands that may be impacted by energy development.

1.6 Invasive Weeds and Wildfire

Invasive weeds are present but not extensive across most of the beardtongues' pollinator habitat, and the primary weed is cheatgrass (*Bromus tectorum*) (USFWS 2020a, p. 55). Most beardtongue populations contain low amounts of cheatgrass (< 5 percent of habitat area); however, a few populations that contain higher levels of cheatgrass include two Graham's beardtongue populations (20 and 27) and one White River beardtongue population (8) (USFWS 2020a, pp. 55 – 57). We expect weed levels to remain low in intact beardtongue occupied habitat and increase in disturbed occupied habitat (USFWS 2020a, Appendix B pp. 8 – 11). The effects of invasive weeds may increase in populations that overlap with energy development, particularly at the subpopulation level in remaining habitat areas that are small, directly adjacent to energy development, and fragmented from other subpopulation areas. We considered the effect of invasive weeds in our future condition evaluation with other factors associated with population resiliency (section 3.1. Development of Future Scenarios).

Wildfires do not occur frequently in Graham's and White River beardtongues pollinator habitat, and there is no evidence that their pollinator habitat or range has experienced or currently is experiencing an altered wildfire regime (USFWS 2020a, pp. 55 – 57). If the beardtongues occupied habitat were to burn, the wildfire(s) would likely result in patchy, low-intensity burns that the beardtongues' would quickly recover from due to their ability to resprout from their roots (Brunson 2012, entire). For our analysis, we assumed that wildfire frequency and extent in beardtongue populations would generally not change from current levels over the next ten years.

1.7 Small Population Size

Small beardtongue populations are more prone to extinction from stochastic events or stressors than larger populations, or in other words, small populations have lower resiliency (McCaffery 2013, p. 1). As noted in our Biological Report on current condition, we considered 12 of the 27 Graham's beardtongue populations to be small in size (4, 7, 8, 9, 12, 16, 18, 19, 21, 24, 25, 26) because they contain fewer than 67 plants and have an estimated extinction risk greater than 10 percent over a 50 year period (USFWS 2020a, pp. 57 – 60). These small populations are distributed across the species' range and collectively comprise less than one percent of all known individuals in the total population. We considered six of the 17 White River beardtongue populations (1, 2, 5, 6, 7, 8) to be small in size because they contain fewer than 200 plants and have an estimated extinction risk greater than 10 percent over a 50 year period (USFWS 2020a, pp. 57 – 60). These small populations are distributed across the species' range and collectively comprise less than one percent of all known individuals in the total population. The remaining populations are considered medium or large sized, and have lower estimated extinction risk into the future. We considered the effect of small population size in our future condition evaluation along with other with other factors associated with population resiliency (section 3.1. Development of Future Scenarios).

1.8 Climate Change

As defined by the Intergovernmental Panel on Climate Change (IPCC), the term ‘‘climate’’ refers to the mean and variability of different types of weather conditions over time, with 30 years being a typical period for such measurements, although shorter or longer periods also may be used (IPCC 2013a, p. 1450). Scientific measurements spanning several decades demonstrate that changes in climate are occurring. In particular, warming of the climate system is unequivocal, and many of the observed changes in the last 60 years are unprecedented over decades to millennia (IPCC 2013b, p. 4). The current rate of climate change may be as fast as any extended warming period over the past 65 million years, and is projected to accelerate in the next 30 to 80 years (National Research Council 2013, p. 5).

Scientists use a variety of climate models, which include consideration of natural processes and variability, as well as various scenarios of potential levels and timing of greenhouse gas emissions, to evaluate the causes of changes already observed and to project future changes in temperature and other climate conditions. Model results yield very similar projections of average global warming until about 2030, and thereafter the magnitude and rate of warming vary through the end of the century depending on the assumptions about population levels, emissions of greenhouse gases, and other factors that influence climate change. Thus, absent extremely rapid stabilization of GHGs at a global level, there is strong scientific support for projections that warming will continue through the 21st century, and that the magnitude and rate of change will be influenced substantially by human actions regarding greenhouse gas emissions (IPCC 2013b, 2014; entire). Global climate projections are informative, and, in some cases, the only or the best scientific information available for us to use. However, projected changes in climate and related impacts can vary substantially across and within different regions of the world (e.g., IPCC 2013c, 2014; entire) and within the United States (Melillo *et al.* 2014, entire). Therefore, we use ‘‘downscaled’’ projections when they are available and have been developed through appropriate scientific procedures, because such projections provide higher resolution information that is more relevant to spatial scales used for analyses of a given species (Glick *et al.* 2011, pp. 58–61, for a discussion of downscaling).

Since we are not aware of a downscaled climate model for the range of Graham’s and White River beardtongue, we used climate change data from the Multivariate Adaptive Constructed Analogs (MACA) website that uses a downscaling method for model output from 20 global climate models to a 2.5 to 4 mi (4 to 6 km) resolution (https://climate.northwestknowledge.net/MACA/index.php). We used two different emission scenarios, a low emission scenario and a high emissions scenario. The low emissions scenario is the Representative Concentration Pathways (RCP) 4.5 emission scenario, and the high emission scenario is the RPC 8.5 emission scenario used by the IPCC. RCP 4.5 is an intermediate emissions scenario where atmospheric carbon dioxide (CO_2) concentrations are expected to equal approximately 650 ppm after the year 2100. In RCP 8.5, emissions aggressively increase to approximately 1370 ppm CO_2 after the year 2100 (IPCC 2014, p. 57; USGS 2017, p. 3). For comparison, current atmospheric CO_2 concentrations are around 400 ppm (USGS 2017, p. 3).

The results of our "downscaled" climate evaluation indicate future climate conditions will be warmer in all seasons under both emission scenarios (Lindstrom 2019, entire). The difference in temperature increase between the two scenarios is within 3.2 ^{O}F through 2070. Spring temperatures under the intermediate emissions scenario (RCP 4.5) and winter temperatures under the high emissions scenario (RCP 8.5) are predicted to increase the most relative to the other seasons. In general, temperatures are predicted to increase by approximately 5 to 6 ^{O}F under the intermediate emissions scenario (RCP 4.5) and approximately 8 to 8.6 ^{O}F under the high emissions scenario (RCP 8.5). Precipitation for all seasons is expected to increase under both scenarios. Spring precipitation under the intermediate emissions scenario (RCP 4.5) and winter precipitation under the high emissions scenario (RCP 8.5) are predicted to increase the most relative to the other seasons. In general, spring, fall, and winter precipitation is predicted to increase between 6 to 9.6 percent under the low emission scenario and between 6.5 to 16 percent under the high emission scenario.

We recognize the effects of increased temperature and precipitation can confound each other, and the effects of increased temperature dominate increased precipitation in some climate models (Stewart *et al.* 2004, p. 224). As temperatures warm, so does evaporation, sometimes negating the effects of increased precipitation because soil water storage may decrease. Evaporative deficit is the difference between water available in the soil and water lost to evapotranspiration. As evaporative deficit increases, the landscape becomes drier, and drought conditions increase.

In order to evaluate a more integrated measure of the combined effect of increased temperature and precipitation levels, we considered a measure of evaporative deficit instead of precipitation alone for our predictions of drought conditions (Lindstrom 2019, entire). The evaporative deficit measure is not available on the MACA website, so we utilized the USGS National Climate Change Viewer (NCVV) at the following website: https://www2.usgs.gov/climate_landuse/clu_rd/nccv/viewer.asp. The NCVV averages the results of 33 global climate models and provides predictions for the same two emissions scenarios. We evaluated the same two emissions scenarios for Uintah County, Utah through 2070. Under both scenarios, the evaporative deficit is predicted to be higher than the historical period during the growing season (March to November). The pattern of the evaporative deficit over a single year is the same under both scenarios. The evaporative deficit steadily increases during the spring, peaks in July, and steadily decreases during the fall. The predicted annual evaporate deficit of the high emission scenario is twice as high as the low emission scenario; 0.6 in/month under the high emissions scenario, and 0.3 in/month under the low emissions scenario. Both scenarios indicate the range of Graham's and White River beardtongues may be drier in the future compared to historical conditions.

Future climate conditions have the potential to impact the future condition of Graham's and White River beardtongues. Here, we discuss what could happen in general to the species' range and abundance under warmer and drier conditions based upon what we know about the biology of the species.

Range Effects

Accelerating rates of climate change of the past two or three decades indicate that the extension of species' geographic range boundaries toward the poles or to higher elevations by progressive establishment of new local populations will become increasingly apparent in the relatively short term (Hughes 2000, p. 60). We do not have evidence of a range contraction or shift for Graham's and White River beardtongues. Both species have the ability to occupy different slope aspects based on their current distribution.

Future climate conditions have the potential to reduce the number of suitable microsites available within population areas. There is also the potential for a range reduction for the beardtongues, particularly in combination with other stressors. When we considered characteristics that contribute to vulnerability to climate change such as dispersal ability, highly specific habitat requirements, and ability to shift distribution in response to environmental conditions, Graham's and White River beardtongues would likely rank moderate or high on the vulnerability index at the species-level (Young *et al* 2012, 133 - 139).

Plant Effects

Graham's and White River beardtongues and other long-lived plants in semi-arid environments may be less vulnerable to the effects of climate change if future climate conditions are within the historic range of natural climatic variation experienced by each species (Tielbörger *et al.* 2014, p. 7). As long-lived species, they have the potential to exhibit a small or delayed response to climate conditions compared to shorter-lived species (Tielbörger *et al.* 2014, p. 2). They can employ adaptations in order to survive periods of resource limitation (i.e., drought), and can respond more slowly with respect to changes in abundance compared to changes in biomass and reproduction (Tielbörger *et al.* 2014, p. 5; Schwinning and Sala 2004, entire). We expect adult plant survival to be less sensitive to drought conditions compared to growth, reproduction, and seedling recruitment for both species (USFWS 2020a, p. 60, Appendix E).

We also expect adult plant survival to be more sensitive to the duration of drought conditions rather than the severity of drought in a given year based on the legacy effect of past precipitation events (Evans *et al.* 2011, entire). Increased temperatures have the potential to result in increased growth and reproduction if water is not limiting or reduced growth and reproduction if water is limiting (Bita and Gerats 2008, p. 1; Warwell and Shaw 2017, p. 1213). For both species, we expect that plants will exhibit a complex response to increased temperatures based on the availability of moisture during the growing season, and the species' temperature tolerance and threshold. Importantly, a species' ability to adapt to changing climate conditions is dependent on its adaptive capacity (existing genetic variation or representation) (Warwell and Shaw 2017, p. 1213).

In summary, climate change effects present substantial uncertainty regarding the future environmental conditions in the range of Graham's and White River beardtongues, but may place an added stress on the species and its habitat, particularly where other stressors are present. Despite characteristics that make the two species vulnerable to climate change, our climate evaluation is too speculative to determine the severity of this stressor to Graham's and White River beardtongues at the population level. Long-lived perennial plants exhibit a range of drought and temperature sensitivity based on physiological (photosynthetic pathway), morphological (rooting depth), and inherent genetic variability (Warwell and Shaw 2017, p. 1205), which all contribute to a species' tolerance (Hoover *et al.* 2015, p. 7 – 11). Additional information regarding each species drought and temperature tolerance is needed for a better assessment of future climate effects. For our analysis, we assumed that climate conditions would generally not change from current levels in beardtongue populations over the next ten years, but may contribute to stronger effects of herbivory and invasive weeds to all beardtongue populations. Over a longer timeframe to 2070, we expect temperatures and drought conditions to increase, but there is substantial uncertainty regarding their impact to the beardtongues.

Uncertainty

Climate models have great utility because they allow us to make projections of how climate may change in the future, but their results should be interpreted cautiously. Models are mathematical representations of what can happen, but they do not always accurately predict future events. Climate models have greatly improved in recent years, but projections for precipitation remain less reliable than those for surface temperature (O'Gorman and Schneider 2009, p. 14744; Trenberth 2011, p. 133; IPCC 2014, p. 56). For our analysis of Graham's and White River beardtongues' future condition, we acknowledge the innate uncertainty associated with climate modeling. Future climate conditions in the beardtongues' ranges are projected to be warmer and drier, but there is substantial uncertainty regarding their impact to the beardtongues.

1.9 Future Protections Afforded to the Beardtongues

In this section we considered the protections afforded to Graham's and White River beardtongues from the 2014 CA and regulatory mechanisms.

Penstemon Conservation Agreement (2014 CA)

The 2014 CA is a voluntary agreement that has a strong implementation record over the past 6 years (USFWS 2020a, pp. 38 – 90; Sheppard and Wheeler 2020, pp. 7 – 12). Signatories include the BLM; Utah Department of Natural Resources (DNR); State of Utah School and Institutional Trust Lands Administration (SITLA); Uintah County, Utah; the Utah Public Lands Policy Coordination Office (PLPCO); and Rio Blanco County, Colorado (Penstemon Conservation Team 2014, and 2018 a,b,c, entire).

The 2014 CA states that protections for the beardtongues will continue on Federal and state lands until July 25, 2034, and protections will continue on private lands until July 25, 2029 (Penstemon Conservation Team 2014, entire; Penstemon Conservation Team 2018 a,b,c, entire). We evaluated the 2014 CA protections afforded to the beardtongues until 2034. We did not consider plants in conservation areas designated as Interim, as these areas provide only short-term protections. Although these areas may in the future be converted to permanently designated conservation areas, they do not currently provide assurances for the long-term benefit of the species. This is consistent with our previous evaluation of the 2014 CA (79 FR 46067, August 6, 2014). We are uncertain of the likelihood of 2014 CA protections continuing beyond 2034 when the CA expires, however it may be possible to renew the CA with willing partners. As part of the CA, we committed to re-evaluate the status of the beardtongues in 2028, prior to the expiration of protections on private lands.

As a result of the 2014 CA, designated conservation areas protect 42 percent of the Graham's beardtongue population (23,280 plants) and 67 percent of the White River beardtongue population (20,813 plants) on Federal and State lands, totaling 42,993 acres, through 2034 (Tables 7 and 8). Designated conservation areas provide protections for 13 Graham's beardtongue populations (1, 2, 3, 5, 6, 13, 20, 22, 23, 24, 25, 26, 27) and 11 White River beardtongue populations (3, 4, 5, 9, 10, 11, 12, 14, 15, 16, 17) across both species' ranges (Tables 7 and 8).

The 2014 CA provides that within designated conservation areas, surface disturbance caps will be applied to allow only a limited amount of new construction for roads and traditional oil and gas development. The caps will prohibit future oil shale and tar sand exploration and development. An avoidance buffer of 300 ft between disturbance and beardtongue plants will be used in conjunction with the surface disturbance caps. For more detail on specific protections, please refer to the Biological Report and 2014 CA (Penstemon Conservation Team 2014, and 2018 a,b,c, entire; USFWS 2020a, pp. 39 – 43).

On Federal lands, where heavy sheep grazing or other severe herbivory impacts are detected, the BLM committed to implement localized management actions with the permittee to promote future avoidance measures within designated conservation areas and beardtongue populations on Federal lands (Penstemon Conservation Team 2015, entire; USFWS 2020a, pp. 52 – 54).

To address invasive weeds, the conservation team is implementing a weed management plan to survey, treat, and monitor weeds in designated conservation areas. This conservation measure reduces the impacts of weeds to the beardtongues in these areas. The conservation team has not yet provided recommendations to land managers regarding wildfire planning and post-wildfire actions in designated conservation areas, as was specified in the 2014 CA. However, wildfire is not expected to be a primary driver of the beardtongues' future condition.

To address small population size, the conservation team developed designated conservation areas to protect small, medium, and large populations of Graham's and White River beardtongues (USFWS 2020a, p. 58). The 2014 CA designated conservation areas contain four small populations of Graham's beardtongue (populations 12, 24, 25, 26) and two small populations of White River beardtongue (populations 5, 9).

To address climate change, as called for in the 2014 CA, the BLM recently installed weather monitoring equipment adjacent to eight monitoring sites to collect local climate data in range units 1 to 5 (McCulley and Hornbeck 2017, p. 2; Penstemon Conservation Team 2019a, p. 8; Sheppard and Wheeler 2020, pp. 17 – 22). The data collected from weather monitoring can be correlated with demography data to determine basic species responses to climate patterns.

Table 7. Protections afforded to Graham's beardtongue populations through 2034 on designated conservation areas and BLM lands.

Range Unit	Population	Current Population Size	Plants in designated conservation areas	Plants with BLM RMP Protections	Plants afforded Protections (% of Population)
1. **Sand Wash**	1	954	421	391	812 (85%)
	2	516	186	330	516 (100%)
	3	371	334	35	369 (99%)
	4	46	0	46	46 (100%)
	5	489	489	0	489 (100%)
	6	288	287	0	287 (100%)
		2,664	**1,717**	**802**	**2,519**
2. **Seep Ridge**	7	50	0	50	50 (100%)
	8	49	0	49	49 (100%)
	9	17	0	0	0 (0%)
	10	266	0	0	0 (0%)
	11	195	0	195	195 (100%)
	12	22	9	0	9 (41%)
	13	11,441	7,204	526	7,730 (68%)
	14	1,263	0	1,263	1,263 (100%)
	15	459	0	459	459 (100%)
	16	33	0	0	0 (0%)
		13,795	**7,213**	**2,542**	**9,755**
3. **Evacuation Creek**	17	370	0	206	206 (56%)
	18	1	0	1	1 (100%)
	19	9	0	9	9 (100%)
	20	19,735	5,031	256	5,287 (27%)
	21	6	0	6	6 (100%)
	22	11,335	5,374	863	6,237 (55%)
		31,456	**10,405**	**1,341**	**11,746**
4. **White River**	23	7,700	3,740	312	4,052 (53%)
		7,700	**3,740**	**312**	**4,052**
5. **Raven Ridge**	24	6	6	0	6 (100%)
	25	27	27	0	27 (100%)
	26	1	1	0	1 (100%)
	27	171	171	0	171 (100%)
		205	**205**	**0**	**205**
Total Population		**55,820**	**23,280 (42%)**	**4,997 (9%)**	**28,277 (51%)**

Table 8. Protections afforded to White River beardtongue populations through 2034 on designated conservation areas and BLM lands.

Range Unit	Population	Current Population Size	Plants in designated conservation areas	Plants with BLM RMP Protections	Plants afforded Protections (% of Population)
2. Seep Ridge	1	3	0	3	3 (100%)
	2	8	0	0	0 (0%)
	3	2,278	290	1,422	1,712 (75%)
	4	8,565	7,676	889	8,565 (100%)
	5	10	10	0	10 (100%)
	6	1	0	1	1 (100%)
	7	77	0	0	0 (0%)
		10,942	**7,976**	**2,315**	**10,291**
3. Evacuation Creek	8	1	0	0	0 (0%)
	9	2,050	99	53	152 (7%)
		2,051	**99**	**53**	**152**
4. White River	10	6,609	5,615	166	5,781 (87%)
	11	5,639	2,957	44	3,001 (53%)
	12	1,679	1,678	0	1,678 (100%)
	13	1,290	0	0	0 (0%)
	14	393	393	0	393 (100%)
		15,610	**10,643**	**210**	**10,853**
5. Raven Ridge	15	384	384	0	384 (100%)
	16	617	617	0	617 (100%)
		1,001	**1,001**	**0**	**1,001**
6. Book Cliffs	17	1,401	1,094	307	1,401 (100%)
		1,401	**1094**	**307**	**1401**
Total Population		**31,005**	**20,813 (67%)**	**2,885 (9%)**	**23,698 (76%)**

<u>Regulatory Mechanisms</u>

State and Private Land Protections

The state and county signatories of the 2014 CA have committed to protect the beardtongues on designated conservation areas on their lands, including private lands located within the counties. Protections are afforded to five Graham's beardtongue populations (1, 13, 20, 22, 23) containing 2,990 plants, and three White River beardtongue populations (11, 12, 17) containing 2,182 plants until 2034. Although conservation agreements are not regulatory mechanisms, signatories can implement conservation measures via regulatory mechanisms, and the State of Utah, Uintah County, Utah, and Rio Blanco County, Colorado used their regulatory authority to implement the specific protections as outlined in the 2014 CA (Penstemon Conservation Team 2014, and 2018 a,b,c, entire; USFWS 2020a, pp. 39 – 43).

There is one state law that protects the beardtongues in Utah on state (SITLA) designated conservation areas and enforces the restrictions identified in the 2014 CA (Utah Code 53C-2-202; SITLA Code R850-150). Uintah County enacted a zoning ordinance to enforce the surface disturbance caps and an avoidance buffer within conservation areas on private lands until 2029 (Penstemon Conservation Team 2014, pp. 28, 35). There are no other regulatory mechanisms that provide protections to the beardtongues on private or state lands in Utah and Colorado.

Federal land Protections

BLM lands include portions of 23 Graham's beardtongue populations (1, 2, 3, 5, 6, 7, 8, 11, 12, 13, 14, 15, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27) and 11 White River beardtongue populations (1, 3, 4, 6, 9, 10, 11, 14, 15, 16, 17). Sixteen Graham's beardtongue populations (2, 4, 5, 6, 7, 8, 11, 14, 15, 17, 18, 19, 21, 24, 25, 26) and seven White River beardtongue populations (1, 4, 5, 6, 14, 15, 16) occur entirely on BLM lands.

Graham's and White River beardtongues are BLM sensitive plant species in Utah and Colorado and are afforded protections at least comparable to (if not greater than) the treatment of species which are candidates for Federal listing (BLM 2008a, p. 43). The BLM resource management plans and any specific and indirect protections for the beardtongues are described below for each state.

In Utah, the Vernal Field Office RMP as amended is the regulatory framework for BLM land management where the beardtongues occur (BLM 2008b, entire). The Vernal Field Office RMP and amendments identify the following measures or stipulations that apply to the beardtongues and their habitat:

- Implement the goals and objectives of conservation agreements (BLM 2008b, pp. 128 – 129).
- Implement a 300 ft avoidance buffer for Graham's beardtongue and other sensitive plant species (BLM 2008b, pp. 18, 24).
- The Controlled Surface Use (CSU) stipulation will be applied to protect fragile soils on steep slopes greater than 30 percent unless an engineering plan is developed to prevent erosion (BLM 2008b, pp. 31).
- No disturbance will be allowed for slopes greater than 40 percent unless other alternatives would cause undue or unnecessary degradation (BLM 2008b, pp. 118).
- The NSO stipulation will be applied to fluid mineral leasing, and where appropriate, to all other surface disturbing activities associated with land use authorizations, permits and leases, including other mineral resources (oil shale, tar sands, traditional oil and gas development) (BLM 2008b, p. 30).
- The unavailable for leasing stipulation will be applied to fluid mineral leasing, and where appropriate, all other surface disturbing activities associated with land use authorizations, permits and leases, including other mineral resources (oil shale, tar sands, traditional oil and gas development) (BLM 2008b, p. 30).

- ACEC designations provide some protection from surface disturbing activities, depending on the restrictions applied to a designated area (BLM 2008b, pp. 35 – 43). There are no ACECs designated in Utah for the beardtongues, but other ACECs occur within both species' ranges.

In Colorado, the White River Field Office RMP as amended is the regulatory framework for BLM land management where the beardtongues occur (BLM 1997, entire; BLM 2015, entire). The White River Field Office RMP and amendments identify the following measures or stipulations that apply to the beardtongues and their habitat:

- The Raven Ridge ACEC designation protects Graham's beardtongue and restricts motorized travel to existing roads and trails, and it includes a NSO stipulation for new oil and gas leases (BLM 1997, pp. 2-19, 2-44).
- The NSO stipulation will be applied within 330 ft of BLM sensitive plant species to fluid mineral leasing, and where appropriate, to all other surface disturbing activities associated with land use authorizations, permits and leases, including other mineral resources (oil shale, tar sands, traditional oil and gas development) (BLM 2015, p. 2-27).
- The CSU stipulation will be applied to protect fragile soils on steep slopes between 35 and 50 percent unless an acceptable plan is developed to prevent erosion (BLM 2015, pp. 1-19, 2-4).
- The NSO stipulation will be applied to slopes 35 percent or greater in landslide areas or 50 percent or greater in steep natural areas unless an acceptable mitigation plan is developed (BLM 2015, p. 1-3).

Outside of designated conservation areas on Federal lands, these measures provide protections to an additional nine percent of the Graham's and White River beardtongue total population (Table 7; Table 8).

In summary, Graham's and White River beardtongues are afforded the same level of protections on state and Federal lands within designated conservation areas until 2034. The species are afforded additional protections outside of designated conservation areas on Federal lands, which include: a 300 ft avoidance buffer; surface disturbance restrictions on steep slopes; areas that are unavailable for leasing and that have NSO stipulations; and ACECs. The designated conservation areas and conservation measures on Federal lands provide protections to 51 percent and 76 percent of the Graham's and White River beardtongues total populations, respectively (Table 7; Table 8).

Chapter 3. Future Condition

We described the current condition of Graham's and White River beardtongues and considered their ecological needs in the Biological Report (USFWS 2020a, entire). In this Chapter, we evaluated each species expected future condition using projections and two plausible scenarios. We utilized the current condition as the baseline from which to evaluate changes to those factors considered important to the beardtongues.

The viability of Graham's and White River beardtongues depends on maintaining multiple self-sustaining populations throughout their range into the future. We considered the presence of more populations in Good or Moderate condition distributed across each species' range to be indicative of higher viability.

3.1 Development of Future Scenarios

We developed two future scenarios, moderate energy development and high energy development, using the forecasts described above for oil shale, tar sands, and traditional oil and gas development, to project the locations of energy development within the beardtongues' populations. We considered energy development to be the primary drivers of future population condition over our 10-year timeframe.

The future scenarios differ based on the locations of the oil shale stressor on the landscape between the moderate and high oil shale forecasts. Our analysis included the following assumptions: commercial development activities for oil shale and tar sands will occur in the next 10 years; and the total loss of plants and habitat will occur where the oil shale and tar sands stressors occur. For traditional oil and gas development, we evaluated each population on a case by case basis, and assumed loss of plants and habitat will occur on non-Federal lands, and that avoidance of plants by 300 ft, with some loss of pollinator habitat, will occur on Federal lands.

Within the area of future energy development we accounted for associated development of roads and other infrastructure and the direct and indirect effects to the beardtongue populations from habitat loss, habitat fragmentation, fugitive dust, and invasive weeds by conservatively assuming total loss of plants and habitat where energy development was projected (USFWS 2020a, entire).

We acknowledge there is uncertainty on how these stressors may change singly and cumulatively, and their effects on each plant species. The two future energy scenarios included the following:

Scenario 1 – Moderate energy development: We evaluated the impact of conservation efforts and stressors (oil shale, tar sands, and traditional oil and gas; road construction and maintenance; herbivory; invasive weeds; and climate change) on Graham's and White River beardtongues (Figure 10; Figure 11). Our analysis included the following assumptions:

- The moderate oil shale forecast where exploration and commercial development would occur in areas identified as high potential for development on non-Federal (State, private) lands. This area overlaps with:
    - Six populations of Graham's beardtongue (populations 13, 17, 18, 19, 20, 22); and
    - Three populations of White River beardtongue (populations 8, 9, 10).

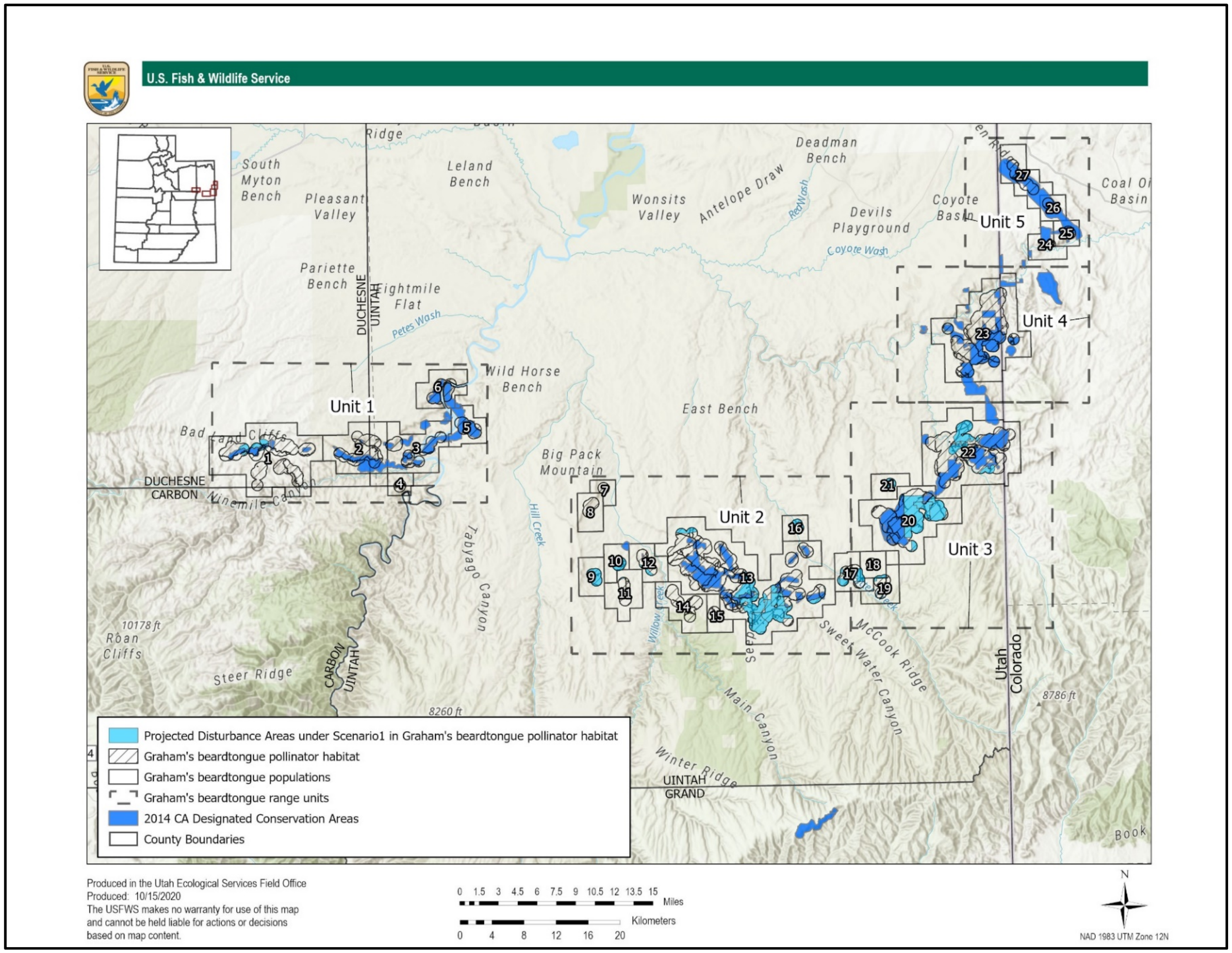

Figure 11. Scenario 1 moderate energy development and Graham's beardtongue populations 1- 27.

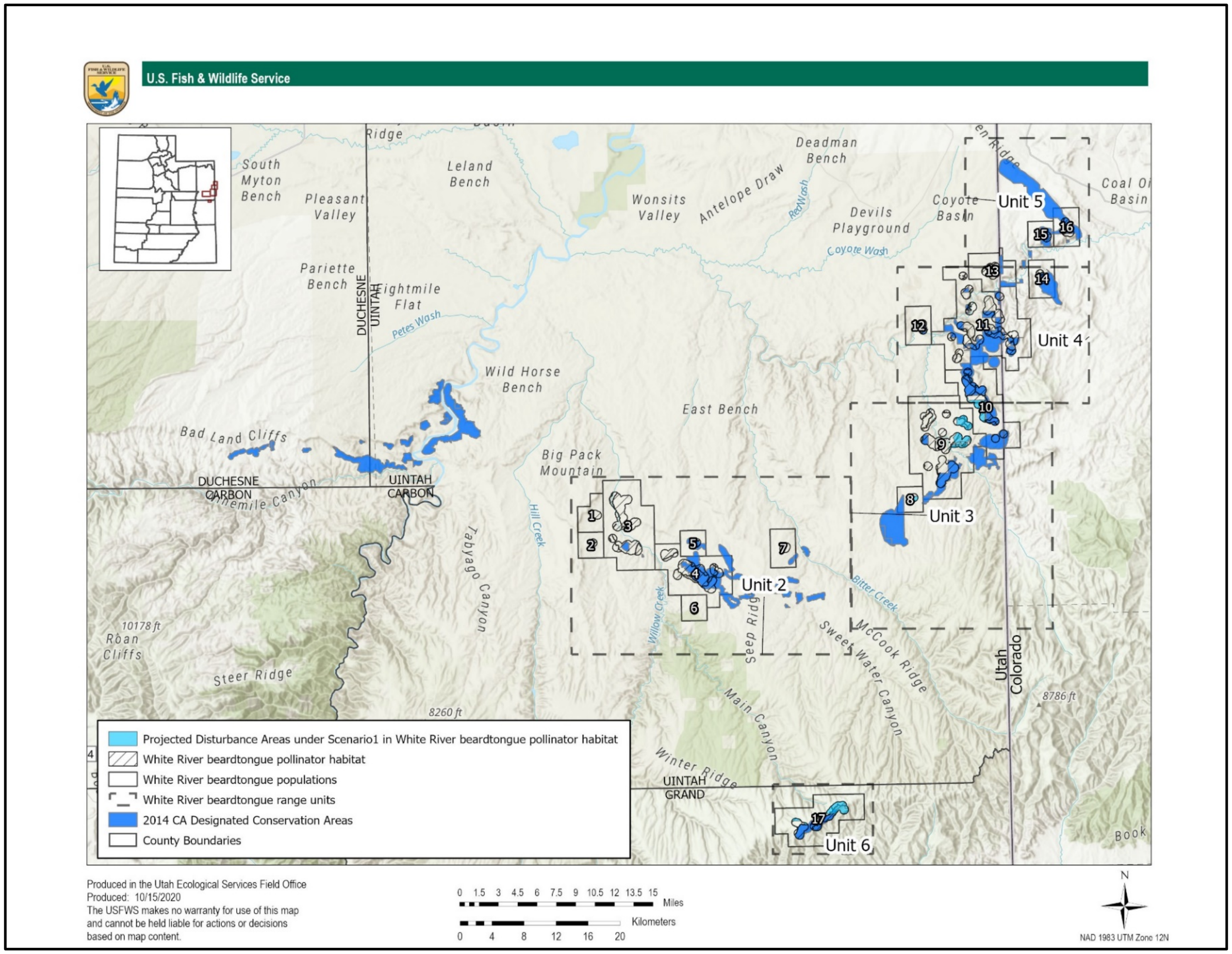

Figure 12. Scenario 1 moderate energy development and White River beardtongue populations 1- 17.

- The tar sands forecast where exploration and commercial development would occur in current lease areas and areas of high exploration potential in the southern PR Springs STSA. This area overlaps with:
  - No populations of Graham's beardtongue; and
  - One population of White River beardtongue (population 17).

- The traditional oil and gas forecast where commercial development would occur in delineated oil and gas fields. This area overlaps with:
  - Ten populations of Graham's beardtongue (populations 1, 9, 10, 11, 12, 13, 15, 16, 21, 22); and
  - One population of White River beardtongue (population 17).

- Road construction and maintenance would be associated with new energy development (oil shale, tar sands, and traditional oil and gas). These areas are already included in our energy development analysis area so we do not analyze this stressor separately.

- Herbivory may increase at a local level within occupied beardtongue habitat on non-Federal lands impacted by energy development. This includes localized areas within six Graham's beardtongue populations (1, 12, 13, 17, 20, 22) and three White River beardtongue populations (9, 10, 17) (Appendix 1).

- Invasive weeds may increase in populations where surface disturbance occurs. This may increase the effect of invasive weeds to populations that overlap with energy development. We evaluated the impact of invasive weeds to habitat quality as part of the habitat future condition evaluation.

- Climate change may contribute to stronger effects of herbivory and invasive weeds to all beardtongue populations.

Scenario 2 – High energy development: We evaluated the impact of conservation efforts and stressors (oil shale, tar sands, and traditional oil and gas; road construction and maintenance; herbivory; invasive weeds; and climate change) on Graham's and White River beardtongues. This scenario identified a larger area for oil shale exploration and development than moderate energy development scenario, in order to evaluate a worst-case scenario, for the purpose of bracketing the full range of plausible future conditions. The assumptions for the other stressors remained the same as the moderate energy development scenario (Figure 12; Figure 13). Our analysis included the following assumptions:

- The high oil shale forecast where exploration and commercial development would occur in areas identified as high potential for development on non-Federal (State, private) lands; non-Federal lands with high economic potential (15 GPT) for surface and underground mining as identified by Utah Geological Survey (UGS); and all lands currently under lease or permit for oil shale. This area overlaps with:
  - Eleven populations of Graham's beardtongue (populations 7, 11, 12, 13, 15, 17, 18, 19, 20, 22, 23); and

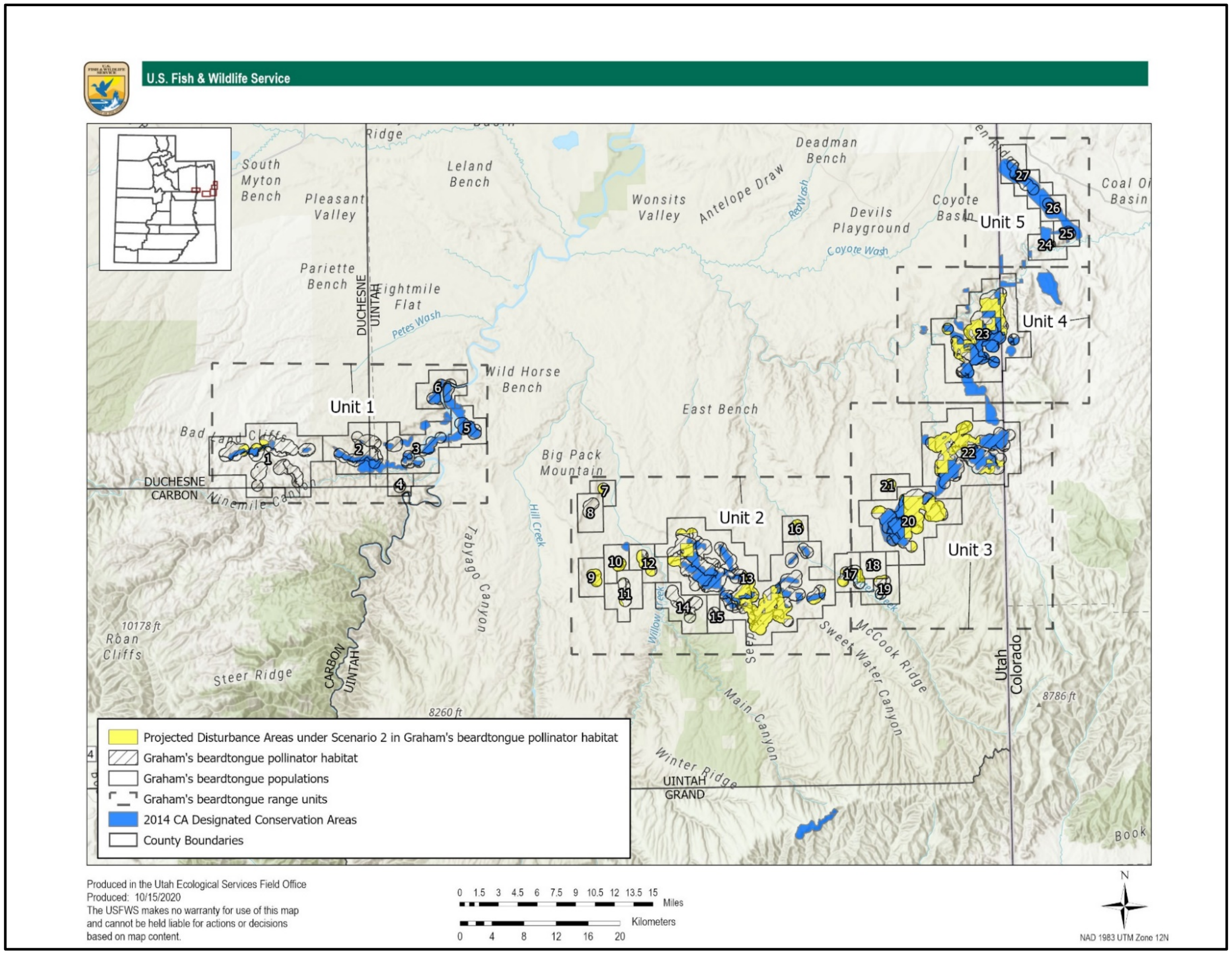

Figure 13. Scenario 2 high energy development and Graham's beardtongue populations 1 - 27.

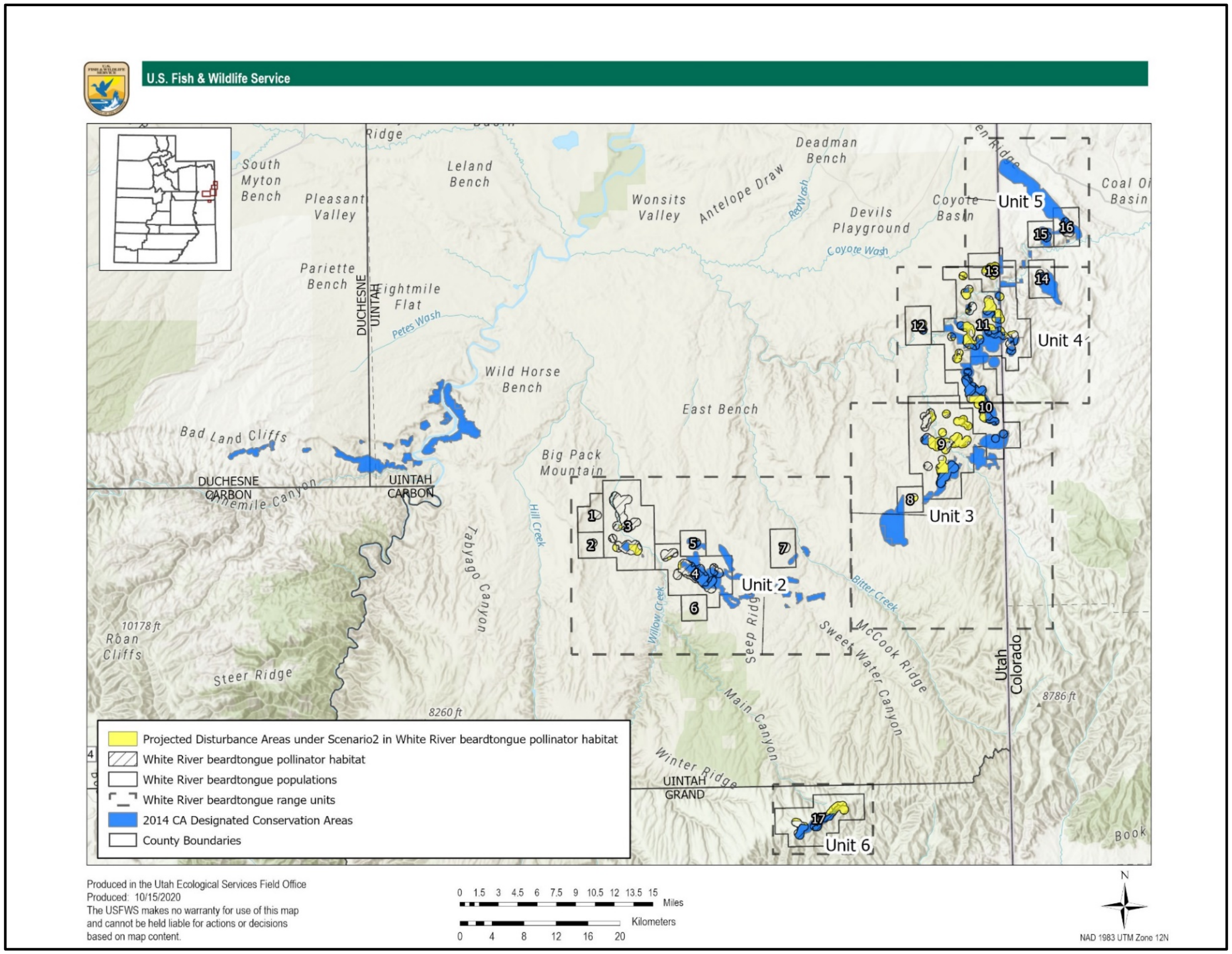

Figure 14. Scenario 2 high energy development and White River beardtongue populations 1 - 17.

    - Eight populations of White River beardtongue (populations 4, 5, 8, 9, 10, 11, 12, 13).

- The tar sands forecast where exploration and commercial development would occur in current lease areas and areas of high exploration potential in the southern PR Springs STSA. This area overlaps with:
    - No populations of Graham's beardtongue; and
    - One population of White River beardtongue (population 17).

- The traditional oil and gas forecast where commercial development would occur in delineated oil and gas fields. This area overlaps with:
    - Ten populations of Graham's beardtongue (populations 1, 9, 10, 11, 12, 13, 15, 16, 21, 22); and
    - One population of White River beardtongue (population 17).

- Road construction and maintenance would be associated with new energy development (oil shale, tar sands, and traditional oil and gas). These areas are already included in our energy development analysis area so we do not analyze this stressor separately.

- Herbivory may increase at a local level within occupied beardtongue habitat on non-Federal lands impacted by energy development near borders and allotment boundary adjustments. This includes localized areas within seven Graham's beardtongue populations (1, 12, 13, 17, 20, 22, 23) and six White River beardtongue populations (3, 9, 10, 11, 12, 17) (Appendix 1).

- Invasive weeds may increase in populations where surface disturbance occurs. This may increase the effect of invasive weeds to populations that overlap with energy development. We evaluated the impact of invasive weeds to habitat quality as part of the habitat future condition evaluation.

- Climate change may contribute to stronger effects of herbivory and invasive weeds to all beardtongue populations.

We used criteria identified in Table 9 and Table 10 to determine the extent of each scenarios' effects within plant populations. We evaluated the likely future condition of each plant population with the same metrics used in our evaluation of current condition, including habitat quality, habitat area, population size, and habitat loss (USFWS 2020a, pp. 64 – 70). We then categorized each factor as Good, Moderate, or Low condition based on the resulting score for each population. Some populations in the Low condition category were reassigned to the Extirpated category if the population may be lost to development. These scenarios considered how conditions are likely to change for the species within a 10-year timeframe based on our energy development forecast timeframe. The results of our analysis are described below.

Table 9. Metrics for evaluating future condition for Graham's beardtongue.

Future Condition					
	Population Size Factor		**Habitat Factors**		
Condition Category	**Probability of Persistence**	**Presence of High Density Clusters**	**Pollinator Habitat Quality**	**Pollinator Habitat Area (ac)**	**Pollinator Habitat Loss Category**
Good	Low Extinction Risk (<5%)	One or More in the Population	Nonnative plant cover 0 - 5%	> 2,600	0 - 5% (Low Loss)
Moderate	Moderate Extinction Risk (6 – 10%)	One or More in the Population	Nonnative plant cover 6 - 25%	1,000 – 2,600	5.1 – 10% (Moderate Loss)
Low	High Extinction Risk (>10%)	None Present	Nonnative plant cover >25%	<1,000	>10% (High Loss)

Table 10. Metrics for evaluating future condition for White River beardtongue.

Future Condition					
	Population Size Factor		**Habitat Factors**		
Condition Category	**Probability of Persistence**	**Presence of High Density Clusters**	**Pollinator Habitat Quality**	**Pollinator Habitat Area (ac)**	**Pollinator Habitat Loss Category**
Good	Low Extinction Risk (<5%)	One or More in the Population	Nonnative plant cover 0 - 5%	> 1,000	0 - 5% (Low Loss)
Moderate	Moderate Extinction Risk (6 – 10%)	One or More in the Population	Nonnative plant cover 6 - 25%	500 – 1,000	5.1 – 10% (Moderate Loss)
Low	High Extinction Risk (>10%)	None Present	Nonnative plant cover >25%	<500	>10% (High Loss)

3.2 Scenario 1 – Moderate Energy Development

Resiliency under Scenario 1 – Under this scenario, the main stressors for Graham’s beardtongue are oil shale and traditional oil and gas, which results in the loss of 34 percent (19,029 plants) of the total population (Table 11). The main stressors change the condition of populations in the center of its range (range unit 2 - Seep Ridge, and range unit 3 - Evacuation Creek), and result in the extirpation of three populations (9, 10, 16) and a decline in the condition of four populations (12, 17, 19, 21) from plant loss or plant and habitat loss. Population condition is maintained in the remainder of its range (range unit 1 - Sand Wash, range unit 4 - White River, and range unit 5 - Raven Ridge).

The Graham's beardtongue projected total population size under Scenario 1 is 36,791, comprised of 24 populations (Table 11). Occupied habitat and pollinator habitat are projected to be 7,642 and 72,455 acres, respectively. The majority of the total population (98 percent) occurs in 12 populations with Good condition; the remaining total population (2 percent) occurs in 12 populations with Moderate (9 populations) and Low (3 populations) condition. Energy development is present within 4 of the 12 populations in Good condition and 3 of the 9 populations in Moderate condition, and we expect these populations to continue to maintain their resiliency in the future despite projected impacts. Fourteen populations in Good and Moderate condition are large in size and have a low extinction risk (< 5 percent over 50 years). Populations in Good condition are less sensitive to plant and habitat loss than populations in Moderate or Low condition, because there is sufficient habitat area and population size remaining to support the overall population condition. The species continues to occupy the extent of its current range and all range units continue to support populations in Good or Moderate condition.

Regarding the other stressors, the road construction stressor was included in the evaluation of impacts from energy development (oil shale and traditional oil and gas). The tar sand stressor was not present within Graham's beardtongue's range. The invasive weed stressor did not change the future condition of Graham's beardtongue populations. The herbivory stressor may increase in six Graham's beardtongue populations (1, 12, 13, 17, 20, 22) at a local level, but we do not expect it to change the future condition of Graham's beardtongue populations over a ten year period. Climate change may increase the effects of invasive weeds and herbivory at a local level, but we do not expect it to change the future condition of Graham's beardtongue populations over a ten year period.

Under Scenario 1, the main stressor for White River beardtongue is oil shale, which results in the loss of one percent of the total population (216 plants). The main stressor changes the condition of two populations (populations 8, 9) in the center of the species' range (range unit 3 - Evacuation Creek), which results in the extirpation of one population (8) and a decline in the condition of one population (population 9) from loss of plants and habitat. Population condition is maintained in the remainder of the species' range (range unit 2 - Seep Ridge, range unit 4 - White River, range unit 5 - Raven Ridge, and range unit 6 - Book Cliffs).

The White River beardtongue projected total population size under Scenario 1 is 30,789, comprised of 16 populations. Occupied habitat and pollinator habitat are projected to be 3,218 and 26,959 acres, respectively. The majority of the total population (82 percent) occurs in 6 populations with Good condition; the remaining total population (18 percent) occurs in 10 populations with Moderate condition. Energy development is present within 2 of the 6 populations in Good condition and 1 of the 10 populations in Moderate condition, and we expect these populations to maintain their resiliency in the future despite projected impacts. Eleven populations in Good and Moderate condition are large in size and have a low extinction risk (< 5 percent over 50 years). Just like Graham's beardtongue, populations in Good condition are less sensitive to plant and habitat loss than populations in Moderate or Low condition because there is sufficient habitat area and population size remaining to support the overall population

Table 11. Scenario 1 - Future condition and size of Graham's beardtongue populations.

Range Unit	Population	Current Condition and Size[11]	Future Condition and Size	Energy Stressor(s)
1. Sand Wash	1	**Good (L)**	**Good (L)**	Oil and gas
	2	**Good (L)**	**Good (L)**	None
	3	**Good (L)**	**Good (L)**	None
	4	**Moderate (S)**	**Moderate (S)**	None
	5	**Good (L)**	**Good (L)**	None
	6	**Good (L)**	**Good (L)**	None
2. Seep Ridge	7	**Moderate (S)**	**Moderate (S)**	None
	8	**Moderate (S)**	**Moderate (S)**	None
	9	**Moderate (S)**	**Extirpated**	Oil and gas
	10	**Good (L)**	**Extirpated**	Oil and gas
	11	**Moderate (L)**	**Moderate (L)**	Oil and gas
	12	**Moderate (S)**	**Low (S)**	Oil and gas
	13	**Good (L)**	**Good (L)**	Oil and gas; Oil shale
	14	**Good (L)**	**Good (L)**	None
	15	**Good (L)**	**Good (L)**	Oil and gas
	16	**Moderate (S)**	**Extirpated**	Oil and gas
3. Evacuation Creek	17	**Good (L)**	**Moderate (L)**	Oil shale
	18	**Moderate (S)**	**Moderate (S)**	Oil shale
	19	**Moderate (S)**	**Low (S)**	Oil shale
	20	**Good (L)**	**Good (L)**	Oil shale
	21	**Moderate (S)**	**Low (S)**	Oil and gas
	22	**Good (L)**	**Good (L)**	Oil and gas; Oil shale
4. White River	23	**Good (L)**	**Good (L)**	None
5. Raven Ridge	24	**Moderate (S)**	**Moderate (S)**	None
	25	**Moderate (S)**	**Moderate (S)**	None
	26	**Moderate (S)**	**Moderate (S)**	None
	27	**Good (L)**	**Good (L)**	None
Total Population		**55,820**	**36,791 (66%)**	

[11] Population size categories – large (L), medium (M), and small (S) are based on extinction risk over 50 years. Large populations have less than 5% extinction risk; medium populations have 6 – 10% extinction risk; and small populations have greater than 10% extinction risk (USFWS 2020a, pp. 71 – 72).

Table 12. Scenario 1 - Future condition and size of White River beardtongue populations.

Range Unit	Population	Current Condition and Size[12]	Future Condition and Size	Energy Stressor(s)
2. Seep Ridge	1	Moderate (S)	Moderate (S)	None
	2	Moderate (S)	Moderate (S)	None
	3	Good (L)	Good (L)	None
	4	Good (L)	Good (L)	None
	5	Moderate (S)	Moderate (S)	None
	6	Moderate (S)	Moderate (S)	None
	7	Moderate (S)	Moderate (S)	None
3. Evacuation Creek	8	Low (S)	Extirpated	Oil shale
	9	Good (L)	Moderate (L)	Oil shale
4. White River	10	Good (L)	Good (L)	Oil shale
	11	Good (L)	Good (L)	None
	12	Moderate (L)	Moderate (L)	None
	13	Moderate (L)	Moderate (L)	None
	14	Moderate (L)	Moderate (L)	None
5. Raven Ridge	15	Moderate (L)	Moderate (L)	None
	16	Good (L)	Good (L)	None
6. Book Cliffs	17	Good (L)	Good (L)	Oil and gas; Tar sands
Total Population		**31,005**	**30,789 (99%)**	

condition. The species continues to occupy the extent of its current range and all range units continue to support populations in Good or Moderate condition.

Regarding the other stressors, the road construction stressor was included in the evaluation of impacts from energy development (oil shale, tar sands, and traditional oil and gas). The invasive weed stressor did not change the future condition of White River beardtongue populations. The herbivory stressor may increase in three White River beardtongue populations (9, 10, 17) at a local level but we do not expect it to change the future condition of White River beardtongue populations over a ten year period. Climate change may increase the effects of invasive weeds and herbivory at a local level, but we do not expect it to change the future condition of White River beardtongue populations over a ten year period.

[12] Population size categories – large (L), medium (M), and small (S) are based on extinction risk over 50 years. Large populations have less than 5% extinction risk; medium populations have 6 – 10% extinction risk; and small populations have greater than 10% extinction risk (USFWS 2020a, pp. 71 – 72).

Redundancy under Scenario 1 – Under this scenario, we project a reduction in redundancy for Graham's and White River beardtongues. We project the extirpation of three out of the 27 Graham's beardtongue populations (9, 10, 16) and the extirpation of one out of the 17 White River beardtongue population (8). Despite the extirpation of populations, levels of redundancy remain high for both species with Graham's beardtongue maintaining 24 populations, and White River beardtongue maintaining 16 populations.

Representation under Scenario 1 – Under this scenario, Graham's beardtongue has 14 large populations distributed across its range with at least one large population in each of the five range units; the remaining 10 populations are small (Appendix 1). Graham's beardtongue continues to occupy the five main vegetation types within its range (the Intermountain Basin big sagebrush shrubland and steppe, the Colorado Plateau low sagebrush shrubland and steppe, Pinyon-Juniper woodlands, the Intermountain Basins mixed salt desert scrub, and shale badlands systems; Appendix 1; USFWS 2020a, p. 72). Our evaluation of these demographic and ecological surrogates for genetic diversity suggests that Graham's beardtongue will maintain a similar level of ecological diversity within the 24 remaining populations to what it has currently, and should have the adaptive capacity to tolerate future climate and habitat conditions. We have no information to indicate that the projected loss of the three Graham's beardtongue populations (9, 10, 16), and projected plant loss in other populations would result in significant impacts to Graham's beardtongue's representation.

Under this scenario, White River beardtongue has 11 large populations distributed across its range with at least one large population within each of the five range units (Appendix 1). The remaining 5 populations are small. White River beardtongue continues to occupy the five main vegetation types within its range (the Intermountain Basin big sagebrush shrubland and steppe, the Colorado Plateau low sagebrush shrubland and steppe, Pinyon-Juniper woodlands, the Intermountain Basins mixed salt desert scrub, and shale badlands systems; Appendix 1; USFWS 2020a, p. 72). Our evaluation of these demographic and ecological surrogates for genetic diversity suggests that White River beardtongue will maintain a similar level of ecological diversity within the 16 remaining populations to what it has currently, and should have the adaptive capacity to tolerate future climate and habitat conditions. We have no information to indicate that the projected loss of the one White River beardtongue population (8), and projected plant loss in other populations would result in significant impacts to White River beardtongue's representation.

3.3 Scenario 2 – High Energy Development

Resiliency under Scenario 2 – Under this scenario, the main stressors for Graham's beardtongue are oil shale and traditional oil and gas, which results in the loss of 46 percent (25,585 plants) of the total population (Table 13). The main stressors change the condition of populations in the center of the species' range (range unit 2 - Seep Ridge and range unit 3 - Evacuation Creek), and result in the extirpation of three populations (9, 10, 16) and a decline in the condition of six populations from plant loss or plant and habitat loss (populations 7, 12, 15, 17, 19, 21). Population condition is maintained in the remainder of the species' range (range unit 1 - Sand Wash, range unit 4 - White River, and range unit 5 - Raven Ridge).

The Graham's beardtongue projected total population size under Scenario 2 is 30,235, comprised of 24 populations (Table 13). Occupied habitat and pollinator habitat are projected to be 6,037 and 63,580 acres, respectively. The majority of the total population (96 percent) occurs in 11 populations with Good condition, and the remaining total population (4 percent) occurs in 13 populations with Moderate (9 populations) and Low (4 populations) condition. Energy development is present within 4 of the 11 populations in Good condition and 4 of the 9 populations in Moderate condition, and we expect these populations to continue to maintain their resiliency in the future despite projected impacts. Fourteen populations in Good and Moderate condition are large in size and have a low extinction risk (< 5 percent over 50 years). Populations in Good condition are less sensitive to plant and habitat loss than populations in Moderate or Low condition because there is sufficient habitat area and population size remaining to support the overall population condition. For example, populations 22 and 23 retain their Good condition and support many thousands of Graham's beardtongue individuals despite projected plant and habitat loss. The species continues to occupy the extent of its current range and all range units continue to support populations in Good or Moderate condition.

Regarding the other stressors, the road construction stressor was included in the evaluation of impacts from energy development (oil shale and traditional oil and gas). The tar sand stressor was not present within Graham's beardtongue's range. The invasive weed stressor did not change the future condition of Graham's beardtongue populations. The herbivory stressor may increase in seven Graham's beardtongue populations (1, 12, 13, 17, 20, 22, 23) at a local level but we do not expect it to change the future condition of Graham's beardtongue populations over a ten year period. Climate change may increase the effects of invasive weeds and herbivory at a local level, but we do not expect it to change the future condition of Graham's beardtongue populations over a ten year period.

Under Scenario 2, the main stressor for White River beardtongue is oil shale, which results in the loss of 23 percent of the total population (7,207 plants) (Table 14). The main stressor changes the condition of four populations (populations 8, 9, 11, 13) in the center of the species' range (range unit 3 (Evacuation Creek) and 4 (White River)), and results in the extirpation of two populations (8, 13) and a decline in the condition of two populations from loss of plants and habitat (populations 9, 11). Population condition is maintained in the remainder of the species' range (range unit 2 - Seep Ridge, range unit 5 - Raven Ridge, and range unit 6 - Book Cliffs).

The White River beardtongue projected total population size under Scenario 2 is 23,798, comprised of 15 populations (Table 14). Occupied habitat and pollinator habitat are projected to be 2,317 and 20,099 acres, respectively. The majority of the total population (76 percent) occurs in 5 populations with Good condition, and the remaining total population (24 percent) occurs in 10 populations with Moderate condition. Energy development is present within 3 of the 5 populations in Good condition and 4 of the 10 populations in Moderate condition, and we expect these populations to maintain their resiliency in the future despite projected impacts. Nine populations in Good and Moderate condition are large in size and have a low extinction risk (< 5 percent over 50 years). Just like Graham's beardtongue, populations in Good condition are less sensitive to plant and habitat loss than populations in Moderate or Low condition because there is sufficient habitat area and population size remaining to support the overall population

Table 13. Scenario 2 Future condition and size of Graham's beardtongue populations.

Range Unit	Population	Current Condition and Size[13]	Future Condition and Size	Energy Stressor(s)
1. Sand Wash	1	Good (L)	Good (L)	Oil and gas
	2	Good (L)	Good (L)	None
	3	Good (L)	Good (L)	None
	4	Moderate (S)	Moderate (S)	None
	5	Good (L)	Good (L)	None
	6	Good (L)	Good (L)	None
2. Seep Ridge	7	Moderate (S)	Low (S)	Oil shale
	8	Moderate (S)	Moderate (S)	None
	9	Moderate (S)	Extirpated	Oil and gas
	10	Good (L)	Extirpated	Oil and gas
	11	Moderate (L)	Moderate (L)	Oil and gas; Oil shale
	12	Moderate (S)	Low (S)	Oil and gas; Oil shale
	13	Good (L)	Good (L)	Oil and gas; Oil shale
	14	Good (L)	Good (L)	None
	15	Good (L)	Moderate (L)	Oil and gas; Oil shale
	16	Moderate (S)	Extirpated	Oil and gas
3. Evacuation Creek	17	Good (L)	Moderate (L)	Oil shale
	18	Moderate (S)	Moderate (S)	Oil shale
	19	Moderate (S)	Low (S)	Oil shale
	20	Good (L)	Good (L)	Oil shale
	21	Moderate (S)	Low (S)	Oil and gas
	22	Good (L)	Good (L)	Oil and gas; Oil shale
4. White River	23	Good (L)	Good (L)	Oil shale
5. Raven Ridge	24	Moderate (S)	Moderate (S)	None
	25	Moderate (S)	Moderate (S)	None
	26	Moderate (S)	Moderate (S)	None
	27	Good (L)	Good (L)	None
Total Population		**55,820**	**30,235 (54%)**	

[13] Population size categories – large (L), medium (M), and small (S) are based on extinction risk over 50 years. Large populations have less than 5% extinction risk; medium populations have 6 – 10% extinction risk; and small populations have greater than 10% extinction risk (USFWS 2020a, pp. 71 – 72).

Table 14. Scenario 2 Future condition and size of White River beardtongue populations.

Range Unit	Population	Current Condition and Size[14]	Future Condition and Size	Energy Stressor(s)
2. Seep Ridge	1	Moderate (S)	Moderate (S)	None
	2	Moderate (S)	Moderate (S)	None
	3	Good (L)	Good (L)	Oil shale
	4	Good (L)	Good (L)	Oil shale
	5	Moderate (S)	Moderate (S)	Oil shale
	6	Moderate (S)	Moderate (S)	None
	7	Moderate (S)	Moderate (S)	None
3. Evacuation Creek	8	Low (S)	Extirpated	Oil shale
	9	Good (L)	Moderate (S)	Oil shale
4. White River	10	Good (L)	Good (L)	Oil shale
	11	Good (L)	Moderate (L)	Oil shale
	12	Moderate (L)	Moderate (L)	Oil shale
	13	Moderate (L)	Extirpated	Oil shale
	14	Moderate (L)	Moderate (L)	None
5. Raven Ridge	15	Moderate (L)	Moderate (L)	None
	16	Good (L)	Good (L)	None
6. Book Cliffs	17	Good (L)	Good (L)	Oil and gas; Tar sands
Total Population		**31,005**	**23,798 (77%)**	

condition. The species continues to occupy the extent of its current range and all range units continue to support populations in Good or Moderate condition.

Regarding the other stressors, the road construction stressor was included in the evaluation of impacts from energy development (oil shale, tar sands, and traditional oil and gas). The invasive weed stressor did not change the future condition of White River beardtongue populations. The herbivory stressor may increase in six White River beardtongue populations (3, 9, 10, 11, 12, 17) at a local level but we do not expect it to change the future condition of White River beardtongue populations over a ten year period. Climate change may increase the effects of invasive weeds and herbivory at a local level, but we do not expect it to change the future condition of White River beardtongue populations over a ten year period.

[14] Population size categories – large (L), medium (M), and small (S) are based on extinction risk over 50 years. Large populations have less than 5% extinction risk; medium populations have 6 – 10% extinction risk; and small populations have greater than 10% extinction risk (USFWS 2020a, pp. 71 – 72).

Redundancy under Scenario 2 – Under this scenario, we project a reduction in redundancy for Graham's and White River beardtongues. We project the extirpation of three out of 27 Graham's beardtongue populations (9, 10, 16) and the extirpation of two out of 17 White River beardtongue populations (8, 13). Despite the extirpation of populations, levels of redundancy remain high for both species with Graham's beardtongue maintaining 24 populations and White River beardtongue maintaining 15 populations.

Representation under Scenario 2 – Under this scenario, Graham's beardtongue has the same number of large (14) and small (10) populations and distribution across its range as Scenario 1 despite a larger projected plant loss (Appendix 1). The species has at least one large population within each of the five range units and continues to occupy the five main vegetation types within its range (the Intermountain Basin big sagebrush shrubland and steppe, the Colorado Plateau low sagebrush shrubland and steppe, Pinyon-Juniper woodlands, the Intermountain Basins mixed salt desert scrub, and shale badlands systems; Appendix 1; USFWS 2020a, p. 72). Our evaluation of these demographic and ecological surrogates of genetic diversity suggests that Graham's beardtongue will maintain a similar level of ecological diversity within the 24 remaining populations to what it currently has, and should have the adaptive capacity to tolerate future climate and habitat conditions. We have no information to indicate that the projected loss of the three Graham's beardtongue populations (9, 10, 16), and projected plant loss in other populations would result in significant impacts to Graham's beardtongues' representation.

Under this scenario, White River beardtongue has one fewer large populations (10) and the same number of small populations (5) and distribution across its range as Scenario 1 (Appendix 1). The species has at least one large population within each of the five range units and continues to to occupy the five main vegetation types within its range (the Intermountain Basin big sagebrush shrubland and steppe, the Colorado Plateau low sagebrush shrubland and steppe, Pinyon-Juniper woodlands, the Intermountain Basins mixed salt desert scrub, and shale badlands systems; Appendix 1; USFWS 2020a, p. 72). Our evaluation of these demographic and ecological surrogates for genetic diversity suggests that White River beardtongue will maintain a similar level of genetic diversity within the 15 remaining populations to what it currently has, and should have the adaptive capacity to tolerate future climate and habitat conditions. We have no information to indicate that the projected loss of the two White River beardtongue populations (8, 13), and projected plant loss in other populations would result in significant impacts to White River beardtongue's representation.

Uncertainty Discussion – We have uncertainty about the acreage and locations of future energy development within the beardtongues' populations as well as impacts to populations for the two scenarios, as discussed here. We identified recommendations to improve the population condition in the Biological Report (USFWS 2020a, pp. 79 – 80).

For our analysis, we assumed traditional oil and gas development would occur in beardtongue populations with delineated oil and gas fields, despite the low level of projected development, and that all beardtongue plants would be lost within delineated fields on non-Federal lands, despite the ability of companies to co-locate wells and infrastructure to avoid loss of plants. Therefore, actual impacts to the species may be less than what is depicted in our projections. We cannot project the location of all new natural gas wells within the beardtongues' ranges outside of delineated gas fields. New wells are not expected to be associated with an approved plan of development for full field development (e.g. concentrated wells and pad locations) but rather by individual lease-holders to drill a few additional well pads within their lease area.

For our analysis, we assumed a larger area of oil shale development in scenario 2 (high energy development) than what was used in scenario 1 (moderate energy development). In both scenarios we assumed that all plants and habitat would be lost from oil shale and tar sands development, so that we could evaluate the worst-case impacts from this stressor; and that commercial development activities for oil shale and tar sands will occur in the next 10 years. The assumptions we made about oil shale and tar sands commercial development activities, and loss of plants and habitat for our analysis allowed us to evaluate the worst-case impacts from these stressors.

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