Conservation Agreement and Strategy for Graham's Beardtongue (*Penstemon grahamii*) and White River Beardtongue (*P. scariosus* var. *albifluvis*)

2019 ANNUAL REPORT

Prepared by the Penstemon Conservation Team

State of Utah School and Institutional Trust Lands Administration
Uintah County, Utah
Utah Public Lands Policy Coordination Office
Utah Division of Wildlife Resources
Rio Blanco County, Colorado
Bureau of Land Management
U.S. Fish and Wildlife Service

June 2020

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CONSERVATION AGREEMENT AND STRATEGY FOR GRAHAM'S BEARDTONGUE (*PENSTEMON GRAHAMII*) AND WHITE RIVER BEARDTONGUE (*P. SCARIOSUS* VAR. *ALBIFLUVIS*):

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APPENDICES

1 PENSTEMON CONSERVATION TEAM ACTIVITIES

The Penstemon Conservation Team was established in 2014 and comprises the signatories of the Penstemon *Conservation Agreement and Strategy for Graham's beardtongue (*Penstemon grahamii) a*nd White River beardtongue (*P. scariosus *var.* albifluvis) (Penstemon Conservation Team 2014). The conservation agreement should be cited as follows:

> Penstemon Conservation Team. 2014. *Conservation Agreement and Strategy for Graham's Beardtongue (*Penstemon grahamii*) and White River Beardtongue (*P. scariosus *var.* albifluvis*)*. Prepared for the State of Utah School and Institutional Trust Lands Administration; Uintah County, Utah; Utah Public Lands Coordination Office; Utah Division of Wildlife Resources; Rio Blanco County, Colorado; Bureau of Land Management; and U.S. Fish and Wildlife Service. Prepared by SWCA Environmental Consultants, Salt Lake City, Utah. July 22, 2014.

All plans and reports for the Utah Conservation Team are available electronically on the SITLA website at:

https://trustlands.utah.gov/in-your-community/conservation/penstemon-conservation-project/

Information included in this annual report summarizes Penstemon Conservation Team (PCT) activities from January 1 – December 31, 2019.

1.1 Mitigation Plan

There were no changes to the Mitigation Plan (PCT 2015a) in 2019.

1.2 Weed Management Plan

There were no changes to the Weed Management Plan (PCT 2015b) in 2019. The Team anticipates changes to this plan in 2020.

1.3 Livestock Grazing Management Plan

There were no changes to the Livestock Grazing Management Plan (PCT 2015c) in 2019. The Team anticipates changes to this plan in 2020.

1.4 Surface Disturbance Plan

There were no changes the Surface Disturbance Plan (PCT 2015d) in 2019.

1.5 Demographic Monitoring Plan

The Penstemon Range-wide Demographic Monitoring Plan (PCT 2017a), initially implemented by BLM VFO in 2017, was continued in 2019. From June through late summer 2019, BLM VFO

botanists monitored 36 plots total (20 White River beardtongue and 16 Graham's beardtongue). Range-wide Penstemon Monitoring will be redesigned and reimplemented in 2020. The plan will be redesigned to allow more efficient range-wide population monitoring and quantification of livestock and native ungulate grazing and weed impacts in beardtongue habitats. We expect the revised plan and first year reimplementation results to be included in the 2020 Annual Report.

1.6 Seed Management Strategy

There were no changes to Seed Management Strategy in 2019.

1.7 Restoration Plan

The Restoration Plan Subcommittee developed an early draft Beardtongue Restoration Plan in late 2017. We expect the plan to be finalized in 2020.

1.8 Penstemon Conservation Team Progress Report

As part of the 2018 Addendum to the Agreement, the Penstemon Conservation Team is required to produce a progress report every five years for the duration of the Agreement. These reports will be included as part of annual reporting in 2019, 2024, and 2029. A final summary report will be completed prior to the end of the Agreement on July 25th, 2034. The purpose of these reports is to summarize conservation accomplishments since the inception of the Agreement. The final 2034 summary report is intended to inform the Service's species status assessment for the beardtongues. The 2019 Penstemon Conservation Agreement and Strategy 2019 Progress Report is provided in Appendix A.

2 IMPLEMENTATION OF CONSERVATION AGREEMENT IN BEARDTONGUE HABITATS

2.1 BLM Vernal Field Office (Utah)

In 2019, the Vernal BLM did not authorize any disturbance or permits within the BLM surface Conservation Units. No new mineral materials permits were granted in or near Penstemon conservation areas or habitat.

2.2 BLM White River Field Office (Colorado)

Utah Gas Corporation (UGC) pipeline project was brought to the Conservation Team in August 2018. UGC brought a pipeline proposal to the White River BLM Field Office (WRFO), the proposal had two alternatives. The preferred proposal was to place an 8" pipeline within an existing BLM road. The other alternative was to place a new 8" line along the side of an existing BLM road temporarily during the fall of 2018 and then move it (summer 2019) to replace an existing 3" line that UGC currently used (the 3" line is approximately 15-20 feet off the road).

Possible mitigation for the project was discussed with the Conservation Team and is provided below. In addition to mitigations discussed it was also decided that further special status plant surveys were required of UGC per WRFO Special Status Plant Species (SSPS) Survey Protocol. The entire proposed/approved pipeline route was going to be surveyed the following bloom season (spring 2019). The reasoning for the "after the fact" survey was for two reasons; the pipeline placement occurred during the dormant season and not during the bloom season (which is when WRFO will only typically accept surveys and deem them valid) and the second reason was that the proposed route lacked any past SSPS surveys. Survey buffers for the survey followed WRFO plant survey protocol.

It was determined by the Conservation Team that the "in road" proposed pipeline placement was acceptable, as long as mitigations were followed and that the additional surveys were going to be done in 2019 (results from the survey were to be provided to the Conservation Team if new occupied habitat was found).

UPDATE: WRFO approved the UGC pipeline to be placed within the existing 1220B BLM numbered road. No new disturbance occurred as a result of the project and all disturbance occurred within the existing BLM road corridor. Provided below is the exact approved SSPS/reclamation mitigation applied to the project. During pipeline construction/placement weekly monitoring reports from a third-party contractor were provided to the BLM Ecologist explaining what occurred during pipeline placement and to ensure all mitigation measures were followed when it came to SSPS plants. During the 2019 bloom season for the beardtongues a SSPS survey for the entire pipeline route was performed (SSPS survey buffer was 300 meters around all edges of disturbances as a result of the pipeline placement). Along the northern portion of the pipeline, where there was previously mapped occupied and suitable habitat for White River beardtongue it was re-affirmed to be occupied (no new population growth). Along the southern portion of the pipeline no new plants and/or suitable habitat was observed.

During the summer of 2019 the abandoned 3" line that UGC previously utilized was removed by the company. The sections of abandoned pipeline that traversed through occupied habitat a third-party monitor was present during removal. Those section were cut into small chunks and were removed by hand to prevent any dragging or crushing of White River beardtongue plants/habitat. No plants or suitable habitat was harmed during removal of the 3" abandoned pipeline. A list of potential mitigation measures presented to the PCT by the WRFO is provided in Appendix B.

2.3 SITLA

SITLA provided funding in support of the implementation of the Penstemon Conservation Agreement totaling $540.00 in 2019. No new leases were issued within Penstemon conservation Areas in 2019.

Sometime in May or June of 2019 approximately 1.6 acres of SITLA land within Section 13 and 14, Township 12 South, Range 24 East designated an interim conservation area was cleared and graded with an access road and pad site constructed by lessee The Oil Mining Company ("TomCo"). The impact of TomCo's disturbance resulted in approximately 1.6 acres of habitat loss, 75 plants directly lost, and impact to 400 plants within the 300-foot avoidance area. The

opportunity to mitigate and minimize impacts to Graham's beardtongue as provided in the Penstemon Conservation Agreement - surveying the area, avoiding plants, salvaging plants, collecting seed for restoration and conservation, future monitoring, and implementing protective conservation measures during construction, was lost. The Penstemon Conservation Team estimated the mitigation costs would have cost TomCo approximately $29,183.18. SITLA informed TomCo in October 2019 that a payment to the Penstemon Mitigation Fund in the amount of $29,183.18 was recommended to offset the lost mitigation opportunity. TomCo has disputed this amount and is currently in negotiations with SITLA to resolve the issue.

2.4 Uintah County

Uintah County actively participated as a Team member throughout 2019.

2.5 State of Utah/The Nature Conservancy

The State of Utah Department of Natural Resources ESMF program provided $59,909 in FY2019 (July 1, 2018 to June 30, 2019) to support pollinator and reproductive success research for *P. grahamii*. This project also received support from The Nature Conservancy Utah. In addition, the Utah DNR provided $8,100 in FY2019 for Conservation Agreement Team support and monitoring activities.

2.6 Summary of Financial Contributions by Partnering Agencies

The Penstemon Conservation Team met seven times in 2019, including five conference calls and two in-person meetings in Vernal, Utah. The direct funds and in-kind contributions associated with these meetings and other Agreement-related activities are summarized in Table 1.

Table 1. 2019 Conservation Agreement Financial Contributions by Partner Agencies

Partner	Direct Funds	In-Kind (hours)
BLM - CO	--	60.0
BLM - UT	--	16.5
Utah DNR	$68,009	160.0
PLPCO	--	83.5
Rio Blanco County, Colorado	--	--
SITLA	$540	79.0
Uintah County, Utah	--	13.0
USFWS - CO	--	16.0
USFWS - UT	--	96.0
TOTAL	**$68,549**	**524.0**

A similar level of participation by the Agreement partner agencies is expected in 2020.

3 CONSERVATION AGREEMENT UPDATES

There were no changes to the Penstemon Conservation Agreement and Strategy in 2019.

4 DATA MANAGEMENT STRATEGY

All reports, publications, data, and literature mentioned in this annual report are compiled in the Penstemon Conservation Team Google Drive site, hosted by SITLA, and are accessible to all conservation team members. Disturbance shapefiles are updated and managed by Uintah County.

4.1 BLM

Any Utah BLM survey data for the beardtongues is submitted to the Utah Natural Heritage Program and Utah Fish and Wildlife Ecological Services Field Office. Any Colorado BLM survey data for the beardtongues is submitted to the Colorado Natural Heritage Program and Colorado Fish and Wildlife Service Field Office.

4.2 Manzanita Botanical Consulting

Any data collected by Manzanita Botanical Consulting in 2019 were submitted to the Penstemon Conservation Team for inclusion in this and future annual reports.

5 2019 FIELD SURVEY RESULTS

Surveys for Graham's and White River beardtongue were limited in 2019. Available survey results are summarized below.

5.1 BLM Vernal Field Office (Utah)

The BLM VFO did not conduct any surveys in 2019.

5.2 BLM White River Field Office (Colorado)

The BLM WRFO conducted surveys of historic element occurrences in 2019.

5.3 State of Utah

No surveys for *P. grahamii* or *P. scariosus* var. *albifluvis* were performed by the Utah Department of Natural Resources or Utah State University in 2019.

5.4 SITLA

There were no surveys conducted on SITLA managed lands in 2019. Pre-construction surveys for Graham's beardtongue at a pad site constructed by lessee The Oil Mining Company ("TomCo") were not completed prior to site development. This disturbance is detailed in Section 2.3.

6 2019 SEED COLLECTIONS

Red Butte Garden collected approximately 20,500 Graham's beardtongue seeds from six sites in Penstemon Conservation Areas in July 2019. These seeds, and an approximately 100,000 White River beardtongue seeds collected as part of the same study in 2018, are banked at Red Butte Garden. The preliminary results of this study are included in Appendix C.

No seed collections were completed as part of implementation of the 2017 Seed Management Plan (PCT 2017b) in 2019.

7 ONGOING RESEARCH

Multiple research and monitoring activities have been implemented as part of the Agreement and are summarized by partner agency below.

7.1 BLM Vernal Field Office

The BLM Vernal Field Office conducted the third year of range-wide demographic monitoring in 2019. The study plots comprised a 1-meter square quadrat centered around a randomly selected beardtongue individual surrounded by a 100 square meter circular plot. Demographic, habitat, and disturbance data were collected within the 1-meter quadrat, with census counts of beardtongue plants within the 100-meter circular plot. Twenty-five plots were established for Graham's beardtongue and 24 plots for White River beardtongue in 2017, but not all plots were revisited in 2018 and 2019 due to logistical difficulties and changes in staffing and resources in the VFO. The 2019 results are summarized for each species in the following sections.

7.1.1 White River Beardtongue 2019 Monitoring Results

BLM botanists revisited 20 monitoring plots from June to September 2019. The plots were not revisited to assess fruiting and seed set due to limited staff and resources. The number of plants in the 100 square meter circular plots ranged from 1 to 570, with an average of 57 plants per plot and 37.0% of plants flowering. The only disturbance noted was native ungulate droppings. No damage was attributed to livestock or off-road vehicles.

7.1.2 Graham's Beardtongue 2019 Monitoring Results

BLM botanists revisited 16 monitoring plots from June to September 2019. The plots were not revisited to assess fruiting and seed set due to limited staff and resources. The number of plants

in the 100 square meter circular plots ranged from 1 to 29, with an average of 9 plants per plot and 33.9% of plants flowering. The only disturbance noted was native ungulate droppings. No damage was attributed to livestock or off-road vehicles.

Because the monitoring program will be revised and reimplemented in 2020, BLM removed climate monitoring equipment (iButton temperature loggers) from the monitoring locations. The iButtons will be redeployed as part of population monitoring reimplementation in 2020. Penstemon population monitoring is expected to continue through 2034.

Maps showing the locations of Graham's and White River beardtongue monitoring plots and BLM AIM monitoring plots in Conservation Units 1-5 are included in Appendix D. There are currently no monitoring sites in Conservation Unit 6 (Book Cliffs, Grand County, Utah).

7.2 BLM Colorado

Annual survey and monitoring activities for both Graham's and White River beardtongue were completed by the BLM Colorado State Office with the help of White River Field Office staff in early July of 2019. Sites monitored included the single, long-term Graham's beardtongue study site in Colorado at Mormon Gap, and the three White River beardtongue study sites established between 2017 and 2018. Several previously mapped Graham's beardtongue occurrences were revisited within the Raven Ridge ACEC as part of an ongoing effort to expand monitoring of suitable populations on BLM managed lands in Colorado. Researchers from the University of Northern Colorado (UNC) joined BLM staff in the field to collect leaf tissue from both species to be used in phylogenetic analysis. No new trend monitoring sites were established in 2019.

The Colorado BLM has been monitoring Graham's beardtongue at Mormon Gap in the Raven Ridge ACEC since the mid 1980's, and this site is the longest running known study of the species. Since 2014, the Colorado BLM has expanded monitoring of both beardtongue species in Colorado. Since 2016, three long-term monitoring study sites have been established at White River beardtongue occurrences in Conservation Units 4 and 5. No additional suitable populations have been identified on BLM managed lands in Colorado.

The BLM Colorado State Office 2019 Monitoring Report is attached as Appendix E.

7.3 Red Butte Garden/Utah Nature Conservancy/DNR

Researchers at the Red Butte Garden Conservation Program implemented a Graham's beardtongue reproductive success study in 2019 (Appendix C), with the aim to investigate links between pollinator visitation, seed set, and surface disturbance are using Rana digital camera technology (Barlow et al. 2017; Barlow and Pavlik 2017) to quantify pollinator visitation to beardtongue flowers. In 2019, Red Butte researchers installed 15 Rana camera units and monitored 49 Graham's beardtongue individuals for a total of approximately 2,300 hours. They documented approximately 2,800 pollinator visits of which approximately 56% were Osmia bees. Researchers also collected seeds to quantify reproductive success.

7.4 Utah DNR Endangered Species Mitigation Fund

Transplant experiments for Graham's and White River beardtongue were carried out in 2014 and 2015 and monitored through ESMF and partner funding in fiscal years (FY) 2014 through 2017, and again in FY2019. The objective of ongoing monitoring is to assess 1) transplant longevity, 2) the ability of transplanted individuals to recruit offspring and potentially function as a natural population, and 3) suitable habitat conditions and potential treatments for enhancing the survival of restored populations. Transplant success monitoring was continued in June 2019 with FY2019 Utah Endangered Species Recovery program funding.

White River beardtongue translocated seedling survival has been variable, with 29 (13.8%) of 210 seedlings surviving to June 2019. However, most of the surviving plants are at the PESCAL-1 site, with 28 (40.0%) of 70 plants surviving and 71.4% of plants flowering in 2019. The PESCAL 2-4 transplant sites were abandoned in 2019 due to high mortality.

We revisited the PEGR-1 Red Leaf Seep Ridge experimental site during Graham's beardtongue flowering on June 5, 2019. Plant survival at the experimental site was low, with only 22 (22.0%) of the original 100 seedlings transplanted in October 2015 surviving to June 2019. Of the surviving plants, 77.3% flowered and averaged 4.9 flowering stems and 52.1 flowers per plant. There were significant differences in caudex diameter, rosette, diameter, stem height, and flower number between the Shale + Utelite and Soil + Utelite treatments (ANOVA; $p < 0.001$). Surviving plants continue to be stressed by competition from dense invasive weeds in the reclaimed soil treatments.

No recruitment has been detected at any of the transplant sites. Transplant monitoring at the Enefit North White River beardtongue and the Seep Ridge Graham's beardtongue experimental sites is planned for 2020.

8 FUTURE SUBCOMMITTEE WORK

The Penstemon Conservation Team has developed six management plans to date. Ongoing and expected future activities associated with these plans are summarized below.

8.1 Demographic Monitoring Plan

The demographic monitoring plan was continued in 2019 with monitoring of 36 plots, include 16 Graham's beardtongue plots and 20 White River beardtongue plots. In 2020, the demographic monitoring plan will be revisited and updated to better address the objectives and needs of Penstemon Conservation Agreement.

8.2 Livestock Grazing Management Plan

Habitat monitoring, as part of the demographic monitoring program, was continued in 2019. However, habitat condition monitoring results to date have not provided sufficiently rigorous data on livestock-related surface disturbance, weeds, and other habitat conditions to support the

objectives of the Livestock Grazing Management, Demographic Monitoring, and Weed Management Plans. The Team expects to revise and reimplement the Plan in 2020.

8.3 Weed Management Plan

Monitoring of weeds in penstemon habitats, as part of the demographic monitoring program, was continued in 2019. Weed management activities took place in the VFO via weed monitoring and control activities provided by Uintah County in 2019. The Team expects to revise and reimplement the Plan in 2020.

8.4 Restoration Plan

The Restoration Plan Subcommittee drafted an outline restoration plan in 2017. There was no additional work on this plan in 2019 due to other team priorities. The plan is expected to be finalized in late 2020.

8.5 Other Future Activities

Ongoing conservation-related research and activities are being conducted by the Agreement partner agencies. Expected 2020 activities include the following:

8.5.1 Pollination & Reproductive Success Study

Red Butte Garden researchers conducted studies of White River beardtongue and Graham's beardtongue pollination and reproductive success in 2018 and 2019, respectively. Analysis of beardtongue pollinator activity video data is ongoing with published results expected in September 2020.

8.5.2 Climate Monitoring

Implementation of range-wide climate monitoring was initiated in 2018 with the installation of iButtons near the demographic monitoring plots established by BLM VFO in 2017. Data logged by the iButtons is still being gathered and analyzed. We expect any remaining iButtons to be collected and redeployed in 2020 at the new monitoring locations.

8.5.3 Seed Collections

Seed collections will continue in 2020 as climate-linked flowering and fruiting permits.

9 LITERATURE CITED

Barlow, S. E., G.A. Wright, C. Ma, M. Barberis, I.W. Farrell, E.C. Marr, and P.C. Stevenson. 2017. Distasteful nectar deters floral robbery. Current Biology 27(16):2552–2558.

Barlow, S., and B. Pavlik. 2017. Estimating the spatial dimensions of *Astragalus holmgreniorum* mutualisms. Pollinator visitation and behaviors along a seed set gradient. Report to the State of Utah Department of Natural Resources Endangered Species Recovery Program and The Nature Conservancy, Utah Field Office, Salt Lake City. 26 pp.

Barlow, S., and B. Pavlik. 2018. Effects of distance to disturbance and population density on pollinator visitation and reproductive output of White River penstemon (*Penstemon scariosus* var. *albifluvis*) and Graham's penstemon (*P. grahamii*). Interim report prepared October 2018 for The Nature Conservancy. 12 pp.

Penstemon Conservation Team. 2014. *Conservation Agreement and Strategy for Graham's Beardtongue (*Penstemon grahamii*) and White River Beardtongue (*P. scariosus *var.* albifluvis*)*. Prepared for the State of Utah School and Institutional Trust Lands Administration; Uintah County, Utah; Utah Public Lands Coordination Office; Utah Division of Wildlife Resources; Rio Blanco County, Colorado; Bureau of Land Management; and U.S. Fish and Wildlife Service. Prepared by SWCA Environmental Consultants, Salt Lake City, Utah. July 22, 2014.

———. 2015a. *Conservation Agreement and Strategy for Graham's Beardtongue (*Penstemon grahamii*) and White River Beardtongue (*P. scariosus *var.* albifluvis*): Mitigation Plan*. Prepared by the Penstemon Conservation Team. July 22, 2015.

———. 2015b. *Conservation Agreement and Strategy for Graham's Beardtongue (*Penstemon grahamii*) and White River Beardtongue (*P. scariosus *var.* albifluvis*): Weed Management Plan*. Prepared by the Penstemon Conservation Team. July 22, 2015.

———. 2015c. *Conservation Agreement and Strategy for Graham's Beardtongue (*Penstemon grahamii*) and White River Beardtongue (*P. scariosus *var.* albifluvis*): Livestock Grazing Management Plan*. Prepared by the Penstemon Conservation Team. July 23, 2015.

———. 2015d. *Conservation Agreement and Strategy for Graham's Beardtongue (*Penstemon grahamii*) and White River Beardtongue (*P. scariosus *var.* albifluvis*): Criteria for the Calculation of Baseline and New Surface Disturbance.* Prepared by the Penstemon Conservation Team. July 22, 2015.

———. 2017a. *Conservation Agreement and Strategy for Graham's Beardtongue (*Penstemon grahamii*) and White River Beardtongue (*P. scariosus *var.* albifluvis*): Demographic Monitoring Plan*. Prepared by the Penstemon Conservation Team. March 31, 2017.

———. 2017b. *Conservation Agreement and Strategy for Graham's Beardtongue (*Penstemon grahamii*) and White River Beardtongue (*P. scariosus *var.* albifluvis*): Seed Management Strategy*. Prepared by the Penstemon Conservation Team. May 30, 2017.

Rodriguez-Pena, R.A., R.L. Johnson, L.A. Johnson, C.D. Anderson, N.J. Ricks, K.M. Farley, M.D. Robbins, A.D. Wolfe, and M.R. Stevens. 2018. Investigating the genetic diversity and differentiation patterns in the *Penstemon scariosus* species complex under different sample sizes using AFLPs and SSRs. *Conservation Genetics* 19:1335–1348.

Appendix A

Penstemon Conservation Agreement and Strategy: 2019 Progress Report

The 2018 Addendum to the Agreement requires 5-year progress reports:

> ***4. AGREEMENT MODIFICATIONS***
>
> ***4.1 Conservation Agreement Reports***
>
> *On or around December 31st, 2019 and every five years thereafter, Signatories hereby agree to complete a summary report of conservation accomplishments since the inception of the Agreement (for the avoidance of doubt, reports are to be completed in 2019, 2024, 2029). The summary reports may replace the annual report for that year. The final summary report shall be completed prior to the end of the Agreement on July 25th, 2034. Summary reports will provide a comprehensive review of conservation efforts and research performed under the Agreement, as well as the status of the beardtongues and habitat conditions within conservation areas. The summary report is intended to inform the Service's species status assessment for the beardtongues. The report will also inform the Penstemon Conservation Team of any conservation actions that would be beneficial to the species and could be implemented prior to the ending of the Conservation Agreement.*

The Penstemon Conservation Agreement and Strategy was finalized and implemented in July 2014. Since its implementation, we have learned a great deal about both beardtongue species' distributions, abundances, and restoration potential. We have gained years of documentation of the effects of natural and anthropogenic threats to populations and habitats. There are also multiple ongoing research projects in progress associated with the goals and objectives of the Agreement.

The Penstemon Conservation Team has been continuously active in the implementation of the Penstemon Conservation Agreement since 2014. The team has been highly effective in the cooperative interagency implementation of the Agreement despite multiple changes in signatory representation and annual changes to leadership. The Team has diligently completed required management plans and annual reports, and USFWS, BLM, SITLA, PLPCO, Uintah County and Utah DNR are directly involved in the funding and implementation of monitoring and research needs. Uintah County and SITLA have provided partner funding to Utah ESMF-funded survey, monitoring, and restoration research projects throughout the agreement. The UDNR has also provided considerable in-kind support. Red Butte Garden has also supported the agreement by providing greenhouse grown seedlings for transplant experiments, staffing, expertise, and in-kind support. The Utah Nature Conservancy has indirectly supported the Agreement by providing funding for research on beardtongue ecology, pollination, and reproductive success.

The Agreement timeline and implementation actions and accomplishments to date are summarized below, including a list of relevant dates and activities that preceded and/or informed the Agreement.

RELEVANT ACTIONS PRECEDING THE PENSTEMON CONSERVATION AGREEMENT:

1975: *USFWS accepts Smithsonian report of plants considered to be endangered, threatened or extinct as a petition to list.*

1976: *USFWS publishes proposed rule to list 1,700 plant species, including Graham's beardtongue.*

1979: *Withdrawal of proposed rule.*

1980: *USFWS designates Graham's beardtongue as a candidate species.*

1982: *White River beardtongue (*Penstemon scariosus *var.* albifluvis*) described.*

1983: *USFWS designates White River beardtongue as a candidate species.*

1990: *Fund for Animals petitions to list 401 species, including Graham's beardtongue.*

2002: *Petition from 5 parties and Court settlement to propose Graham's beardtongue for listing.*

2004: *Red Butte Garden Conservation Program implements long-term monitoring at two populations each for Graham's and White River beardtongue.*

2005: *The Colorado BLM implements Graham's beardtongue population monitoring at the Mormon Gap study site in the Raven Ridge ACEC.*

2006: *USFWS publishes proposed rule to list Graham's beardtongue as threatened with critical habitat. USFWS withdraws proposed rule.*

2008: *USFWS 2006 withdrawal of proposed rule challenged by four parties.*

2011: *Court vacates the withdrawal of the proposed rule. White River beardtongue included in a legal agreement to review and address the needs of the species.*

2013: *Colorado BLM documents a statistically significant decrease ($p < 0.01$) in the Graham's beardtongue population at Mormon Gap following a livestock trailing event in 2013. The population is reduced by approximately half from 2005-2012 observations.*

August 2013: *USFWS publishes proposed rules to list Graham's and White River beardtongues and 67, 959 and 14,914 acres of designated critical habitat, respectively, under ESA.*

Late 2013: *SITLA, PLPCO, and Uintah County initiate the development of a conservation agreement for Graham's and White River beardtongues.*

Early 2014: *Ad hoc formation of a Penstemon Conservation Team comprised of federal, state, and county stakeholders from Utah and Colorado. The team includes rare plant biologists with specialized experience with the species, decision makers, and resource managers.*

March-April 2014: *Utah DNR Endangered Species Mitigation Fund and state conservation partners provide funding for FY2014 and FY2015 beardtongue surveys and conservation activities to support implementation of the pending Conservation Agreement and Strategy.*

May-June 2014: *Targeted surveys for Graham's and White River beardtongue completed with funding from ESMF (FY2014), SITLA, and Uinta County. Red Butte Garden Conservation Program cultivates White River beardtongue seedlings for fall 2015 transplant experimentation. Industry-funded range-wide surveys for both species conducted on SITLA oil shale leases.*

June 2014: *BLM VFO and SWCA botanists (ESMF FY2014) collect genetic material and morphological data from White River beardtongue populations to support Brigham Young University (BYU) genetics research funded in part by BLM VFO. Voucher specimens collected and submitted to BYU.*

July 2014: *Penstemon Conservation Agreement and Strategy finalized.*

ACTIONS AND ACCOMPLISHMENTS UNDER THE AGREEMENT 2014-2019:

August 2014: The Penstemon Conservation team is formally established with elected chair, co-chair, and secretary.

October 2014: Red Butte Garden and SWCA botanists translocate 70 White River beardtongue seedlings into native habitats on Enefit Private Conservation Areas at Gilsonite Canyon.

November 2014 side note: 2004-2012 results of Red Butte Garden Conservation Program long-term monitoring of Graham's and White River beardtongue indicate that populations of both species are relatively stable but are susceptible to decline with changes to their habitats, increased stressors, or catastrophic events (McCaffery et al. 2014).

Early 2015: BLM VFO incorporates beardtongue conservation agreement language into National Environmental Policy Act documents. SITLA completes conservation area designations

through rulemaking. Penstemon Conservation Team coordinates with SITLA and oil shale lessees on development activities. Utah ESMF funds ongoing conservation research activities for FY2016.

May-June 2015: BLM VFO, SWCA (ESMF FY2015), and the Utah Natural Heritage Program conduct beardtongue surveys throughout the Uinta Basin. Surveys focus on extremes of range for both species. BYU researchers confirm a range expansion for White River beardtongue in Grand County, Utah with funding from Uintah County and others. BYU researchers continue to collect White River beardtongue genetic material with support from BLM VFO. Contract botanists monitor the October 2014 White River beardtongue transplants and document 75% survival. Contract botanists conduct pilot monitoring study in the Hells Hole livestock grazing allotment to assess methods for quantifying livestock disturbance and invasive weeds in occupied habitat. Seeds collected for both species and submitted to the Red Butte Garden Conservation Program.

July 2015: Penstemon Conservation Team finalizes management plans for livestock grazing, weeds, surface disturbance, and mitigation. The 2014 Conservation Agreement and Management Plans are published on SITLA's Penstemon Conservation Agreement webpage (https://trustlands.utah.gov/in-your-community/conservation/penstemon-conservation-project).

August 2015: Contract botanists coordinate with Red Leaf Resources managers on development of a soil restoration treatment experiment at the Seep Ridge oil shale lease location. Red Leaf constructs four soil treatment plots and a fenced enclosure as in-kind support to the Agreement.

October 2015: Uintah County volunteers, and Red Butte Garden and SWCA botanists transplant 140 White River beardtongue seedlings into native habitats on Enefit Private Conservation Areas at Park Canyon and Watson. Botanists from USFWS, BLM VFO, Red Butte Garden, and SWCA install 100 Graham's beardtongue seedlings at the Red Leaf Seep Ridge experimental soil treatment site.

March 2016: Penstemon Conservation Team finalizes and publishes the 2015 Annual Report.

April 2016: Utah ESMF funds ongoing conservation activities for FY2017.

May-June 2016: Contract botanists monitor White River beardtongue transplants at Gilsonite Canyon (68.6% survival), Park Canyon (26.1% survival), and Watson (31.0% survival). BLM VFO and contract botanists monitor the Graham's beardtongue transplant experiment at Red Leaf Seep Ridge EPS site (99% survival). Variation in transplant success apparently due to native ungulate herbivory and variability in habitat conditions between the sites.

July 2016: BLM VFO and contract botanists collect seed for both beardtongue species and submit seeds for accession to the Red Butte Garden Conservation Program.

Fall 2016: BLM VFO botanists document new Graham's beardtongue occurrences in the Wrinkles Road area.

January 2017: Penstemon Conservation Team finalizes the Penstemon Seed Management Strategy. SITLA funds ongoing technical support to the Penstemon Conservation Team.

March 2017: Penstemon Conservation Team finalizes and publishes the 2016 Annual Report.

May 2017: Penstemon Conservation Team finalizes the Penstemon Demographic Monitoring Plan.

May-June 2017: Penstemon pilot demographic monitoring study is implemented by BLM VFO, DNR, and contract botanists with the establishment of 25 monitoring plots for each species. SWCA implements a pilot reproductive success study for White River beardtongue. Fifty iButton climate monitoring devices acquired with ESMF (FY2017) funding to support BLM VFO monitoring program. The BLM WRFO implements population monitoring of White River beardtongue in the Raven Ridge ACEC. Botanists (ESMF FY2017) implement pilot study to examine relationship between White River beardtongue reproductive success and surface disturbance. Results are inconclusive.

December 2017: Penstemon Conservation Team produces draft Penstemon Restoration Plan.

January 2018: SITLA funds ongoing technical support to the Penstemon Conservation Team.

March 2018: Penstemon Conservation Team finalizes and publishes its 2017 Annual Report.

May-June 2018: BLM VFO botanists continue Penstemon demographic monitoring, with revised methods to reduce the number of visits to each plot. BLM VFO implements range-wide climate monitoring with the installation of iButtons near the demographic monitoring plots. BLM VFO botanists conduct pre-disturbance and distribution surveys for both beardtongue species.

June 2018: Red Butte Garden Conservation Program (RBGCP) initiates a reproductive success and pollinator monitoring study at five White River beardtongue study populations in BLM and State Conservation Areas with support from ESMF and Utah Nature Conservancy. RBGCP documents very high pollinator visitation and collects approximately 100,000 White River beardtongue seeds. The Colorado BLM continues population monitoring of White River beardtongue and completes the 14th year of Graham's beardtongue population monitoring at the Raven Ridge ACEC. Colorado BLM establishes additional monitoring plots in the Weaver Canyon and Sheep Trail areas.

July 2018: Uintah County amends the Uintah County Interim Overlay Zone ordinance established as part of the 2014 agreement to clarify permitting requirements for surface disturbance and add sections defining surface disturbing activities and mitigation. Two parcels were removed from the Penstemon Conservation Overlay Zone as part of this amendment.

November 2018: Penstemon Conservation Team publishes first addendum to the 2014 Penstemon Conservation Agreement. The Addendum extends the Agreement period to a 20-year term (2014 to 2034) and adds requirements for 5-year summary reports of conservation accomplishments to be completed by the Penstemon Conservation Team in 2019, 2024, 2029, and 2034, and a species status assessment to be completed by USFWS in 2028.

Early 2019: The Penstemon Conservation Team publishes changes to conservation area boundaries that adds 2,339 acres as new conservation areas for White River beardtongue habitat on BLM and SITLA lands and removes 115 acres of low priority conservation areas.

January 2019: Utah ESMF funds technical support to the Penstemon Conservation Team and monitoring and research activities for FY2019.

April 2019: Utah ESMF funds ongoing technical support to the Penstemon Conservation Team and monitoring and research activities for FY2020.

May-June 2019: Red Butte Garden Conservation Program initiates a reproductive success and pollinator monitoring study for Graham's beardtongue at five populations on BLM and State Conservation Areas with support from ESMF and the Utah Nature Conservancy. RBGCP documents 2,800 pollinator visits to 49 individual plants and collects 20,500 Graham's beardtongue seeds.

June 2019: Penstemon Conservation Team finalizes and publishes its 2018 Annual Report.

Fall-Winter 2019/2020: Penstemon Conservation Population Monitoring subcommittee comprised of DNR, USFWS, and Colorado and Utah BLM biologists revises population monitoring program sampling and monitoring methodology. Develops monitoring reimplementation strategy for 2020.

December 2019: Uintah County and Utah DNR offer funding and in-kind support, and the Colorado BLM State Office offers technical and in-kind support for reimplementation of Range-wide Penstemon Population Monitoring in 2020.

OTHER INFORMATION:

The BLM VFO and WRFOs have been essential in implementing and staffing range-wide monitoring activities, and have offered invaluable assistance for population monitoring reimplementation in 2019 and 2020. Nevertheless, there have been challenges to implementing the Agreement and 2015 management plans as written:

- In 2015, BLM VFO had dedicated full-time weed management, range, and botany staff; this is no longer the case and there are currently not enough staff resources to implement the monitoring programs as written.

- The Team is not privy to BLM monitoring programs or data, whereby the number and placement of existing BLM livestock grazing monitoring (AIM) plots do not necessarily reflect conditions in beardtongue populations.

- There is no authority under the Agreement to change existing grazing leases, whereby any changes to grazing management would need to take place when the permit is up for renewal by BLM.

The Team is currently working on solutions to these implementation issues and will revise the Livestock Grazing, Weed, and Population Monitoring Plans in 2020 with achievable objectives

and monitoring programs. The Team has identified the following solutions to the issues raised above:

The Team has coordinated with VFO and Colorado BLM biologists on reimplementing range-wide beardtongue population monitoring in May and June 2020. The revised monitoring program will be designed to address beardtongue population, weed, and livestock grazing objectives. The revised monitoring approach will be based on a macroplot design that will allow annual monitoring to be completed effectively but with minimal staff resources.

The Team incorporate disturbance monitoring methods as part of population monitoring reimplementation. Direct placement of disturbance monitoring plots within the population monitoring plots will allow the Team to quantify relationships between changes in beardtongue population density, surface disturbance, invasive weeds, and livestock and/or native ungulate browsing or trampling.

The Team will coordinate with BLM to work directly with livestock allotment lessees where livestock issues are identified.

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Appendix B

BLM White River Field Office Disturbance Mitigation Measures

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POSSIBLE MITIGATION PRESENTED TO THE PENSTEMON CONSERVATION TEAM

1. All seed tags will be submitted via Sundry Notice (SN)/letter to the designated Natural Resource Specialist/Realty Specialist within 14 calendar days from the time the seeding activities have ended. The SN will include the purpose of the seeding activity (i.e., seeding well pad, cut and fill slopes, seeding pipeline corridor, etc.). In addition, the SN will include the pipeline, well(s) or well pad number associated with the seeding activity, if applicable, the name of the contractor that performed the work, his/her phone number, the method used to apply the seed (e.g., broadcast, hydro-seeded, drilled), whether the seeding activity represents interim or final reclamation, the total acres seeded, an attached map that clearly identifies all disturbed areas that were seeded, and the date the seed was applied.
2. The operator/holder will be responsible for ensuring that all disturbance GIS and reclamation data will be submitted via White River Data Management System (WRDMS) which can be accessed at https://my.usgs.gov/wrfo/
3. The operator must meet the following reclamation success criteria, and these standards apply to both interim and final reclamation:

    a) Self-sustaining desirable vegetative groundcover consistent with the site Desired Plant Community (DPC) (as defined by the range site, WRFO Assessment, Inventory, and Monitoring (AIM) protocol site data (BLM TN 440), ecological site or an associated approved reference site) is adequately established, as described below, on disturbed surfaces to stabilize soils through the life of the project.

    b) Vegetation with 80 percent similarity of desired foliar cover, bare ground, and shrub and/or forb density in relation to the identified DPC. Vegetative cover values for woodland or shrubland sites are based on the capability of those sites in an herbaceous state.

    c) The resulting plant community must have composition of at least five desirable plant species, and no one species may exceed 70 percent relative cover to ensure that site species diversity is achieved. Desirable species may include native species from the surrounding site, species listed in the range/ecological site description, AIM data, reference site, or species from the BLM approved seed mix. If non-prescribed or unauthorized plant species (e.g., yellow sweetclover, *Melilotus officinalis*) appear in the reclamation site, BLM may require their removal.

    d) Bare ground does not exceed the AIM data, range site description, or if not described, bare ground will not exceed that of a representative undisturbed DPC meeting the Colorado Public Land Health Standards.
4. Personnel and activities associated with the construction, drilling, production, and operations of the Proposed Action will be confined to the permitted well pad location,

access road, and pipeline ROW. Prior to well pad construction a temporary orange construction fence will be installed by the project proponent to deter any foot/construction traffic in and around the well pad and access route location. A third party monitor will advise on orange fence placement to ensure plants and suitable white shale habitat is protected. After completion, the orange fence must be removed.

5. For reclamation the BLM recommends modified Seed Mix #3 (see Table 11 below). The mix has been modified to increase the number of forbs as well as reduce the competitive grass species. It is recommended that seeding occur between September 1 and March 31. If an alternate date of seeding is requested, contact the designated Natural Resource Specialist prior to seeding for approval. Drill seeding is the preferred method of application and drill seeding depth must be no greater than ½ inch. If drill seeding cannot be accomplished, seed should be broadcast at double the rate used for drill seeding, and harrowed into the soil.

Table 11. Recommended modified BLM Seed Mix #3.

Seed Mix	Cultivar	Common Name	Scientific Name	Application Rate (lbs PLS/acre)
3	Whitmar	Bluebunch Wheatgrass	*Pseudoroegneria spicata ssp. inermis*	3.5
	Rimrock	Indian Ricegrass	*Achnatherum hymenoides*	4
		Needle and Thread Grass	*Hesperostipa comata ssp. comata*	3.5
	Maple Grove	Lewis Flax	*Linum lewisii*	1
		Scarlet Globemallow	*Sphaeralcea coccinea*	1
		Sulphur Flower Buckwheat	*Eriogonum umbellatum*	1.5

6. Application of herbicides must comply with the Vegetation Treatments on Bureau of Land Management Lands in 17 Western States Programmatic Environments Impact Statement (EIS), and the WRFO Integrated Weed Management Plan (DOI-BLM-CO-110-2010-0005-EA).
    a. All sites shall be monitored and treated for noxious weeds on an annual basis for the life of the project until Final Abandonment has been approved by the BLM.

b. All herbicide use must comply with special status plant species buffers found in DOI-BLM-CO-110-2010-0005-EA.

c. Invasive species found in and near special status plant species populations must be manually controlled. Surrounding areas must be spotted treated with backpack sprayers. BLM must approve all herbicides used within 300 meters of special status plant species populations.

d. Herbicide applicator personnel must be trained in the identification of the nearby special status plant species.

7. All equipment that may act as a vector for weeds shall be cleaned before entering the project area.

8. All seed, straw, mulch, or other vegetative material to be used on BLM lands will comply with United States Department of Agriculture (USDA) state noxious weed seed requirements and must be certified by a qualified Federal, State, or county office as free of noxious weeds. Any seed lot with test results showing presence of State of Colorado A or B list species will be rejected in its entirety and a new tested lot will be used instead. All areas identified to be disturbed under this proposal will be monitored and treated for noxious weeds on an annual basis for the life of the project until Final Abandonment has been approved by the Authorized Officer.

9. Pesticide Use Proposals (PUPs) must be submitted to and approved by the BLM before applying herbicides on BLM lands. The PUP will include target weed species, the herbicides to be used, application rates and timeframes, estimated acres to be treated, as well as maps depicting the areas to be treated and known locations of weeds. The WRFO recommends that all PUPs be submitted no later than March 1st of the year anticipating herbicide application.

10. Pipeline placement must occur outside of the growing season (placement can occur from late September through March) to avoid indirect impacts to special status plant species. In the event placement must occur during the growing season, fugitive dust must be aggressively controlled on all road and work areas using water only, free of any chemicals, oils, or solvents.

11. Third-party oversight will be required for pipeline placement. The third party contractor must be a qualified botanist and be able to identify local special status plant species. The oversight monitor, as well as the BLM NRS, must be notified more than one week prior to activities. The oversight monitor will ensure:

    a. The occupied and suitable habitat is properly protected during earth moving activities are on-going.

    b. Dust suppression activities are effective. If large plumes of dust are visible, the monitor can alert the project manager to temporarily halt activities until water can be applied.

c. Since pipeline placement may last several weeks, the monitor can be present during project onset and then as many times a week, but no less than once per week.

d. If the monitor sees activities that impact the special status plant species and habitat, they must notify BLM immediately and activities may be halted.

e. Oversight monitors must submit to BLM WRFO ecologist a site visit report of all monitoring visits.

12. The WRFO BLM ecologist will be notified if any maintenance is required after the initial project is completed. All mitigation measures must be followed for maintenance activities. Maintenance actions may require additional special status plant species surveys.

13. If, the project is not initiated within 3 years of the biological survey, all occupied and suitable habitat must be re-surveyed. The results of the survey must be provided to the BLM before further ground disturbing activities occur.

14. Where protected populations are within 300 feet, vehicle traffic for projects will obey a speed limit of 15 miles per hour (mph) from March 15 to October 15 on permitted dirt roads for the life of the project. A map of occupied White River beardtongue will be provided to Robert Bayless LLC by WRFO BLM in order to make sure areas needing to be signed for speed limits are correctly placed.

15. If surface pipelines are approved to occur within 300 feet of plants, pipelines will be stabilized or anchored to the ground in order to avoid movement of the pipeline that would result in habitat disturbance or damage to individual plants.

APPROVED MITIGATION FROM NEPA DOCUMENT PREPARED BY WRFO

1. Each year by January 1st, the holder will submit a Reclamation Status Report (for the three inch pipeline removal area) to the WRFO via the most current BLM approved data management system that includes the pipeline name and/or well number, API number, legal description, UTM coordinates, project description (e.g., well pad, pipeline, etc.), reclamation status (e.g., interim or final), whether the well pad and/or pipeline has been re-vegetated and/or re-contoured, date seeded, photos of the reclaimed site, acres seeded, seeding method (e.g., broadcast, drilled, hydro-seeded, etc.), and contact information for the person responsible for developing the report. The report will include maps showing each point (i.e., well pad), polygon, and/or polyline (i.e., pipeline) feature that was included in the report. The data must be submitted in UTM Zone 13N, NAD 83, in units of meters. In addition, scanned copies of seed tags that accompanied the seed bags will be included with the report. Internal and external review of the WRFO Reclamation Status Report and the process used to acquire the necessary information will be conducted annually, and new information or changes in the reporting process will be incorporated into the report.

2. The holder will be responsible for ensuring that all disturbance GIS and reclamation data will be submitted via White River Data Management System (WRDMS) which can be accessed at https://my.usgs.gov/wrfo/
3. All equipment that may act as a vector for weeds will be pressure washed before entering the proposed project area.
4. Application of herbicides must comply with the Vegetation Treatments on Bureau of Land Management Lands in 17 Western States Programmatic Environments Impact Statement (EIS), the WRFO Integrated Weed Management Plan (DOI-BLM-CO-110-2010-0005-EA and the Conservation Agreement and Strategy for Graham's Beardtongue (*Penstemon grahamii*) and White River Beardtongue (*P. scariosus var. albifluvis*) Weed Management Plan).
    - All sites shall be monitored and treated for noxious weeds on an annual basis for the life of the project until Final Abandonment has been approved by the BLM.
    - All herbicide use must comply with special status plant species buffers found in DOI-BLM-CO-110-2010-0005-EA.
    - Invasive species found in and near special status plant species populations must be manually controlled. Surrounding areas must be spotted treated with backpack sprayers. BLM must approve all herbicides used within 300 meters of special status plant species populations.
    - Herbicide applicator personnel must be trained in the identification of the nearby special status plant species.
5. Application of herbicides must be under field supervision of an EPA-certified pesticide applicator. Herbicides must be registered by the EPA and application proposals must be approved by the BLM.
6. Pesticide Use Proposals (PUPs) must be submitted to and approved by the BLM before applying herbicides on BLM lands. The PUP will include target weed species, the herbicides to be used, application rates and timeframes, estimated acres to be treated, as well as maps depicting the areas to be treated and known locations of weeds. The WRFO recommends that all PUPs be submitted no later than March 1st of the year anticipating herbicide application.
7. Any range improvement projects such as fences, water developments, water lines, cattleguards, gates, or other livestock handling/distribution facilities that are damaged or destroyed either directly or indirectly as a result of implementation of the Proposed Action shall be promptly (at least prior to the livestock grazing permittee's need to utilize the range improvement) repaired or replaced by the operator to restore it to at least its pre-disturbance functionality. If the holder damages any range improvement project(s) the holder will notify the Authorized Officer and identify the actions taken to repair the feature(s).

8. All seed, straw, mulch, or other vegetative material to be used on BLM lands will comply with United States Department of Agriculture (USDA) state noxious weed seed requirements and must be certified by a qualified Federal, State, or county office as free of noxious weeds. Any seed lot with test results showing presence of State of Colorado A or B list species will be rejected in its entirety and a new tested lot will be used instead. All areas identified to be disturbed under this proposal will be monitored and treated for noxious weeds on an annual basis for the life of the project until Final Abandonment has been approved by the Authorized Officer.
9. All seed tags will be submitted via letter to the designated Realty Specialist within 14 calendar days from the time the seeding activities have ended. The letter will include the purpose of the seeding activity (i.e., seeding pipeline corridor, etc.). In addition, the letter will include the pipeline associated with the seeding activity, if applicable, the name of the contractor that performed the work, his/her phone number, the method used to apply the seed (e.g., broadcast, hydro-seeded, drilled), whether the seeding activity represents interim or final reclamation, the total acres seeded, an attached map that clearly identifies all disturbed areas that were seeded, and the date the seed was applied.
10. For reclamation pertaining to the 3 inch pipeline removal the BLM recommends modified Seed Mix #3 (Table 11). The mix has been modified to increase the number of forbs as well as reduce the competitive grass species. It is recommended that seeding occur between September 1 and March 31. If an alternate date of seeding is requested, contact the designated Realty Specialist prior to seeding for approval. Seed should be broadcast at double the rate and raked into the soil. At the time of final abandonment for the buried 8 inch line a final reclamation seed mix will be recommended at that time if necessary.

Table 12. Recommended modified BLM Seed Mix #3.

Seed Mix	Cultivar	Common Name	Scientific Name	Application Rate (lbs PLS/acre)
3	Whitmar	Bluebunch Wheatgrass	*Pseudoroegneria spicata ssp. inermis*	3.5
	Rimrock	Indian Ricegrass	*Achnatherum hymenoides*	4
		Needle and Thread Grass	*Hesperostipa comata ssp. comata*	3.5
	Maple Grove	Lewis Flax	*Linum lewisii*	1
		Scarlet Globemallow	*Sphaeralcea coccinea*	1

		Sulphur Flower Buckwheat	*Eriogonum umbellatum*	1.5

11. The holder must meet the following reclamation success criteria for final reclamation along the 3-inch pipeline removal route:

    a) Self-sustaining desirable vegetative groundcover consistent with the site Desired Plant Community (DPC) (as defined by the range site, WRFO Assessment, Inventory, and Monitoring (AIM) protocol site data (BLM TN 440), ecological site or an associated approved reference site) is adequately established, as described below, on disturbed surfaces to stabilize soils through the life of the project.

    b) Vegetation with 80 percent similarity of desired foliar cover, bare ground, and shrub and/or forb density in relation to the identified DPC. Vegetative cover values for woodland or shrubland sites are based on the capability of those sites in an herbaceous state.

    c) The resulting plant community must have composition of at least five desirable plant species, and no one species may exceed 70 percent relative cover to ensure that site species diversity is achieved. Desirable species may include native species from the surrounding site, species listed in the range/ecological site description, AIM data, reference site, or species from the BLM approved seed mix. If non-prescribed or unauthorized plant species (e.g., yellow sweetclover, *Melilotus officinalis*) appear in the reclamation site, BLM may require their removal.

    d) Bare ground does not exceed the AIM data, range site description, or if not described, bare ground will not exceed that of a representative undisturbed DPC meeting the Colorado Public Land Health Standards.

12. Personnel and activities associated with the construction and operations of the Proposed Action will be confined to the permitted pipeline ROW (existing 3-inch pipeline removal) and existing road surface (8-inch pipeline placement). Prior to the 8-inch pipeline placement and 3-inch pipeline removal, a temporary orange construction fence will be installed by the holder to deter any foot/construction traffic around known occupied locations for special status plant species. A third party monitor will advise on orange fence placement to ensure plants are protected (a map of currently mapped occupied habitat will be provided by BLM to the third party contractor). After completion of the 8-inch pipeline placement and 3-inch pipeline removal the orange fence must be removed by the project proponent.

13. The 8-inch pipeline placement and construction, along with removal of the 3-inch pipeline must occur outside of the growing season (placement and removal can occur from late September through March) to avoid indirect impacts to special status plant species. In the event placement must occur during the growing season, fugitive dust must

be aggressively controlled on all road and work areas using water only, free of any chemicals, oils, or solvents.

14. Third party oversight will be required for 8-inch pipeline placement and 3-inch pipeline removal. The third party contractor must be a qualified botanist and be able to identify local special status plant species. The oversight monitor, as well as the BLM Realty Specialist, must be notified more than one week prior to activities. The oversight monitor will ensure:
    - The occupied and suitable habitat is properly protected during earth moving activities and/or pipeline movement.
    - Dust suppression activities are effective. If large plumes of dust are visible, the monitor can alert the project manager to temporarily halt activities until water can be applied.
    - The monitor must be present during all dirt moving activities for the full length of the 8-inch pipeline to ensure all activities are staying within the existing road footprint. When the 3-inch line is removed the monitor will be present for all removal near mapped occupied habitat for special status plant species.
    - If the monitor sees activities that impact special status plant species and suitable habitat, they must notify BLM immediately and activities will be halted.
    - Oversight monitors must submit to BLM WRFO ecologist a weekly site visit report of all monitoring activities.
15. The entire length of the Proposed Action will be surveyed during the bloom window of 2019. Special Status Plant Species surveys will follow the most current Bureau of Land Management (BLM) White River Field Office (WRFO) Little Snake Field Office (LSFO) Kremmling Field Office (KFO) Standards for Contractor Inventories for Special Status Plant Species & Noxious Weed Affiliates Protocol. The results of the survey must be provided to the BLM ecologist before the 3-inch pipeline removal. A "Notice to Proceed" shall be required prior to any non-emergency activities that would cause surface disturbance on the 3-inch pipeline right-of-way. Depending on survey results, additional mitigation may be applied to help protect special status plant species.

16. The BLM ecologist will be notified if any maintenance is required after the initial project is completed, maintenance actions may require additional special status plant species surveys.

17. If the project is not initiated within three years of the most current biological survey, all occupied and suitable habitat must be re-surveyed. The results of the survey must be provided to the BLM before further ground disturbing activities occur.
18. Where protected populations are within 300 feet, vehicle traffic will obey a speed limit of 15 miles per hour (mph) from March 15 to October 15 on permitted dirt roads for the life of the

project. A map will be provided to the holder by WRFO BLM in order to make sure areas needing to be signed for speed limits are correctly placed.

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Appendix C

Red Butte Garden
Reproductive Success Study
Interim Report Year 2

November 2019

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Effects of Distance to Disturbance and Population Density on Pollinator Visitation and Reproductive Output of White River Penstemon (*Penstemon albifluvis*) and Graham's Penstemon (*P. grahamii*)

INTERIM REPORT (Yr 2)

November 2019

Authors

Sarah E. Barlow, Avery B. Uslaner & Bruce M. Pavlik

Red Butte Garden and Arboretum

Prepared for: TNC

Penstemon grahamii

1. Title: Effects of Distance to Disturbance and Population Density on Pollinator Visitation and Reproductive Output of White River Penstemon (*Penstemon albifluvis*) and Graham's Penstemon (*P. grahamii*)

2. Proponent: Red Butte Garden and Arboretum
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3. Project Location: BLM and SITLA lands in the Uintah Basin, Utah

4. Project Responsibilities:

Administration: University of Utah, Red Butte Garden and Arboretum
Other Participants: The Nature Conservancy (funding), U.S. Fish and Wildlife Service (permit), SITLA (funding, permit and site access), Bureau of Land Management (permit, site access)

5. Project Summary:

This project is investigating the causal links between pollinator visitation, seed set, and disturbance-related variables for two rare oil-shale endemics: White River Penstemon (***Penstemon albifluvis***, **PENALB**) and Graham's Penstemon (***P. grahamii,*** **PENGRA**). Field studies were undertaken on PENALB in 2018 (Yr 1) and on PENGRA in 2019 (Yr 2) at five populations for each species at broad spatiotemporal scales. We have used cutting-edge "Rana" technology to quantify pollinator visitation rates to *Penstemon* flowers throughout the flowering seasons in each year of study. Rana is an **automated digital monitoring system** that uses computer vision to record time-compressed videos of insects visiting flowers over extended time periods [1–3]. Multiple, field-deployed Rana units enable simultaneous monitoring of individuals across populations. As such, it provides an unbiased record of time-stamped, species-specific observations that can be statistically linked to pollination services (fruit development and seed set) on monitored plants. Manually scoring Rana videos can be a time-consuming task; hence, in late-2018, we began developing a machine learning model with the aim of further automating the recognition and scoring of pollinators in videos. Our first model iteration is encouraging but is not sufficiently accurate at this stage. All video data has been scored manually and, in total, we used 15 Rana units to monitor 49 PENGRA individuals for ~2300 h and recorded ~2800 foraging visits of which ~56% were *Osmia* bees. During this year's fieldwork, we collected sound data of *Osmia* visiting flowers to test the hypothesis that these bees sonicate Penstemon flowers. Analysis of this sound data is underway. For each species, large seed collections from multiple individuals were made at all study populations and are banked at RBG (PENALB 2018, 100,000 seeds; PENGRA 2019, 20,500 seeds). In addition, we have quantified a range of biotic (e.g. population density, floral display size) and abiotic (e.g. daily temperature, distance to roads, density of road network and well pads) variables. Hence, we now have large ecological datasets for PENALB and PENGRA based on extensive spatiotemporal

monitoring and thousands of pollinator foraging visits, extensive fruit and seed collections, and metrics pertaining to a complex multivariable system operating at a range of temporal (e.g. pollinator phenology) and spatial scales (individual plants to landscape). For each species, we will use Structural Equation Modelling (SEM) [4] to test the causal structure of the complex multivariate relationships affecting pollinator visitation and pollination services (plant reproductive fitness). **The model outputs will be used to make conservation management recommendations for maintaining the pollination mutualisms essential for persistence and recovery.**

6. Recap of research on PENALB in 2018 (Yr 1)

We have constructed a large ecological dataset on PENALB pollinator visitation rates (based on ~1500 h of monitoring and ~1500 pollinator visits), reproductive output (fruit and seed production) and extensive biotic and environmental metrics operating at a variety of spatiotemporal scales. This dataset will be analyzed with Structural Equation Modelling [4] (see section 8 on pg. 8).

Insects collected in 2018 and sent to the USDA Bee Biology & Systematics Laboratory at USU (henceforth, the 'Bee Lab') were misplaced before being identified. In 2019, we made repeat insect collections at PENALB field sites. These specimens have been received by the Bee Lab and are awaiting identification.

Approximately 100,000 PENALB seeds are banked at RBG.

7. Progress report for PENGRA in 2019 (Yr 2)

We have successfully accomplished the goals of this project's second field season as set out in the project proposal. This interim report details the research undertaken in 2019 on PENGRA including fieldwork, Rana video scoring, seed processing and formatting of large ecological datasets for PENGRA and PENALB in preparation for Structural Equation Modelling [4]. During fieldwork, we undertook additional work to investigate whether *Osmia* bees sonicate flowers of PENALB (a hypothesis resulting from field observations in 2018). Preliminary analysis of this sound data is underway. In addition, we describe our progress in developing a machine learning model to further automate the processing of image data recorded by Rana.

7.1 *Study Sites*

In 2019, field studies were undertaken at five sites occupied by endemic PENGRA populations in Uintah County, UT. The site names are Buck Canyon (BC), Blue Knoll East (BKE), two areas within a Department of Wildlife reserve (DWR1, DWR3), and Holiday (HOL) (Fig. 1, Fig. 2a & b). To select PENGRA sites, we followed the same methodology used in 2018 to select PENALB sites, namely: i) sites are located within the Penstemon Conservation Area (PCA) on public lands or permissible private land; ii) sites are accessible for purposes of installing the Rana monitoring equipment i.e. within 100 m of a track accessed by a 4x4 vehicle; iii) previous census data inferred variation in population density and distance to roads (2017 census data were provided by H. Hornbeck, Manzita Botanical Consulting; and,

2017-1978 census data were provided by R. Reisor, U.S. Fish & Wildlife Service as ArcGIS Shapefiles; see also [5,6]) and ground-truthing revealed suitable variation in this regard; and, iv) the logistics of working at all sites was feasible given the expansive spatial distribution of PENGRA populations. We considered up to 15 sites before selecting the final five.

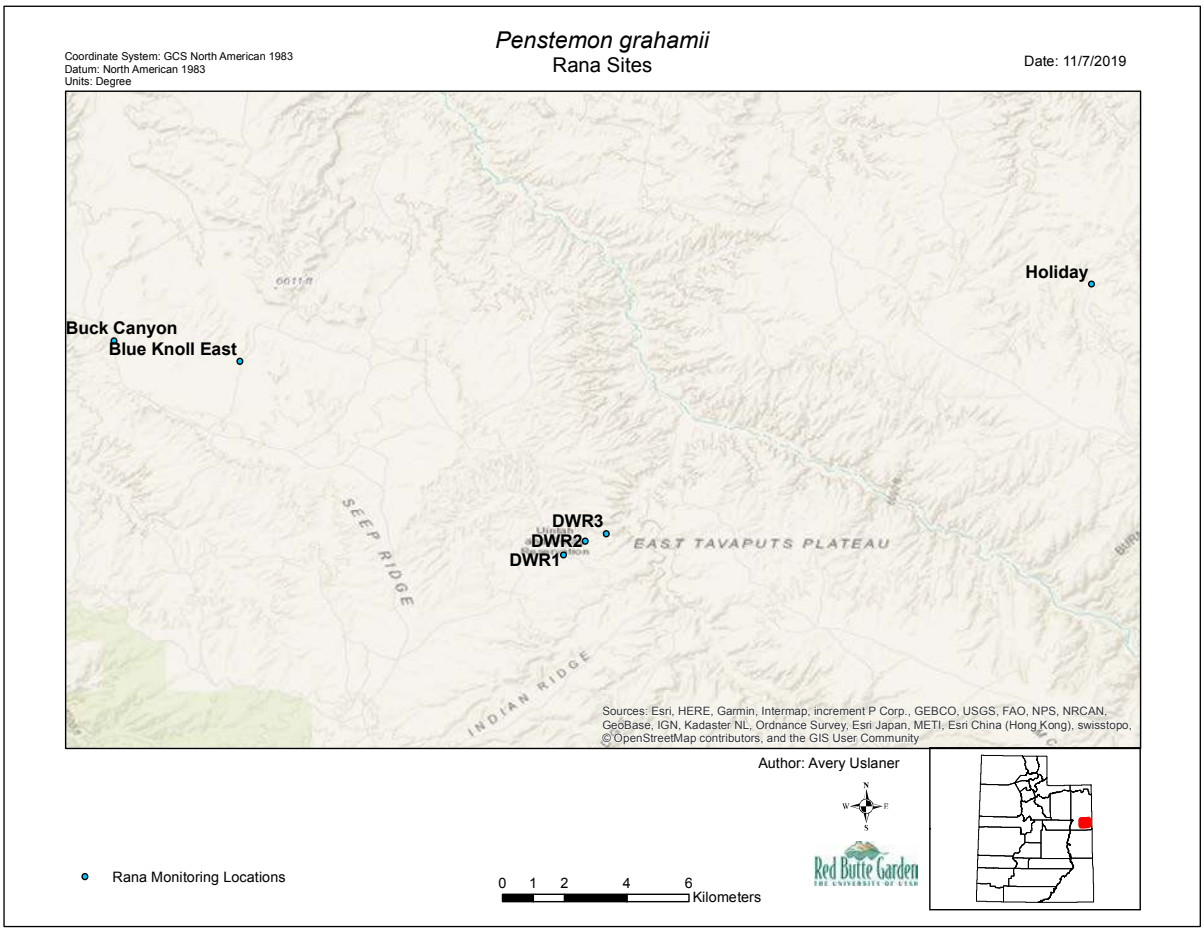

Fig. 1. Spatial distribution of *Penstemon grahamii* sites selected for Rana pollinator monitoring and seed collections in Uintah Co. between May and July 2019. (Note, DWR2 was excluded from the final study design). Geolocation data is available on request.

7.2 *Pollinator monitoring*

Pollinator monitoring methodology follows that used to study PENALB in 2018.
To quantify pollinator visitation, we observed insects visiting flowers using Rana, a novel automated monitoring system (Tumbling Dice Ltd, Newcastle upon Tyne, UK) [1–3] (Fig. 2b-e). The Rana program uses computer vision (blob detection and automated tracking) to record insects visiting flowers over extended time periods and compiles the recorded footage as time-compressed and time-stamped video. Videos (.mpeg) are then manually interpreted using editing software (Virtualdub) to produce extensive datasets on visitation frequency, behaviors and diversity of insect visitors.

At the start of the season, temperature data loggers were deployed at each study site and remained *in situ* until seeds were collected. The weather was unseasonably cool and wet during April and May causing some delay in the onset of flowering within all populations, particularly at the Holiday site. Insect pollinator phenology was also seemingly delayed by the weather. The causal relationships between temperature, flowering and pollinator phenology, pollinator visitation rate and seed set will be examined using Structural Equation Modelling (SEM) (see section 8 on pg. 8).

During May and June and spanning the entire PENGRA flowering period at all sites, 15 Rana units were deployed at the study sites (typically three per site but dependent on the availability of flowering plants throughout the season) (Fig. 2b). A Rana unit monitored the flowers of a PENGRA individual between 07:00 and 20:00 for 2-12 days (determined by anthesis and availability of flowering plants) before being moved to a different individual and the monitoring process repeated throughout the flowering period at each site. All monitored individuals were tagged with a unique identifying number and their GPS location and demographic measurements recorded including basal diameter, number of flowers and flowering stems. At the end of monitoring, each plant was marked with a flag to aid relocation during seed collection. In total, 49 plants were monitored by Rana across all sites (BC, n = 9; BKE, n = 9; DWR, n = 7; DWR3, n = 14; HOL, n = 10).

Throughout the monitoring period, insect specimens were collected with sweep nets, transferred to killing vials and preserved by cold temperature conditions, and returned to Red Butte Garden (RBG). If insects were captured while foraging, the identity of the plant species was also recorded. Insects were pinned at RBG and Hymenoptera sent to the USDA 'Bee Lab' for identification by experts (results pending). Identified specimens will be used to aid the identification of insects recorded by Rana.

7.2.1 *Rana video processing and data summary*

In total, 49 plants were monitored for ~2300 h throughout the PENGRA flowering period resulting in an extensive dataset of pollinator observations. Time-compressed Rana videos were scored manually in Virtualdub (typically a daily 13 h observation period 07:00-20:00 is condensed into a 1-5 min video) (Fig. 2c-e). All insect visits to PENGRA flowers were recorded as: i) the type of visitor specified to highest attainable taxonomic level; ii) insect body size (tiny, small, medium, large) (method described in [2]); and, iii) visitor behavior described as nectar and/or pollen foraging, body position and whether contact was made with a flower's reproductive parts. The total monitoring time per plant was determined and data summarized as the relative number of visits per plant per hour by each of the predominant pollinators (= Pollinator Visitation Rate, PVR). For a subsample of plants, the time of each insect visit was recorded in order to analyze temporal visitation patterns over several consecutive days (this data is pending analysis).

7.2.2 *Use of Machine Learning in Analysis of Penstemon Footage*

While Rana itself seeks to condense the amount of video footage to include only pollinator visitation events, long segments of empty footage without pollinators can still end up in the final video recordings (e.g. due to excessive flower movement in windy conditions). To

increase the speed and efficiency of manual video evaluation, we attempted to further reduce the amount of empty footage by filtering the video using an image-based artificial intelligence binary classification algorithm. While consulting with Dustin Webb of AI Influx, LLC, we experimented with various machine learning models to help classify each frame of video as either pollinator present or absent.

The majority of our models were based on the VGG16 convolutional neural network originally developed by Simonyan and Zisserman in [7]. Such models are trained using large numbers of manually labeled images so as to "teach" the algorithm the differences between various image categories (e.g. prevent vs. absent). At present, our dataset contains 33,703 examples of pollinator absent frames and 34,111 examples of frames with pollinators (like those shown in Fig. 2c-e) representing a total of 41.56 GB of image data. While one of our latest models was able to achieve an accuracy of 91% on a small test set of 200 images, that same model failed to adequately categorize frames when applied to entire videos.

These results demonstrate that our models are able to recognize key differences between frames with and without pollinators and thus provides hope that such algorithms could become valuable tools towards achieving more automated pollinator video evaluation. That said, our current algorithms are clearly struggling to deal with the full spectrum of variables present in the entire Rana recorded videos. Variations in light levels, video quality, focus, species composition, and occlusion of pollinators behind plant parts can all serve to confuse the algorithm into misclassifying the image. This particular classification problem is made all the more difficult by the fact that pollinators themselves represent a small fraction of the total image, making it difficult for the model to isolate key features of a pollinator.

Going forward, these problems might be overcome by training the models with more labeled data or by refocusing how we use the models. For example, it might be possible to train the models exclusively on high quality examples where pollinators are clearly visible, thus helping the algorithm to focus on pollinator features rather than distracting environmental factors. This model would likely be unable to identify low quality examples of pollinators (e.g. blurred or occluded) but we could compensate for that by making the logical assumption that the previous and following frames also include that pollinator.

7.2.3 *Interim results for Pollinator Visitation*

Our working dataset is based on 2797 total foraging visits, principally by *Osmia* bees (1560 visits, 56%; Fig. 2c). Other frequent visitors included flies within the family Bombyliidae (257, 9%), *Anthophora* bees (230, 8%), *Pseudomasaris vespoides* (pollen wasps) (144, 5%; Fig. 2d)) and various species of small bees (207, 7%). Other infrequent visitors (1-100 visits) were tiny, small or medium-sized species of bee and fly, butterflies and moths (Fig. 2e), and hummingbirds. This dataset will be incorporated into Structural Equation Modelling (see section 8 on pg. 8)

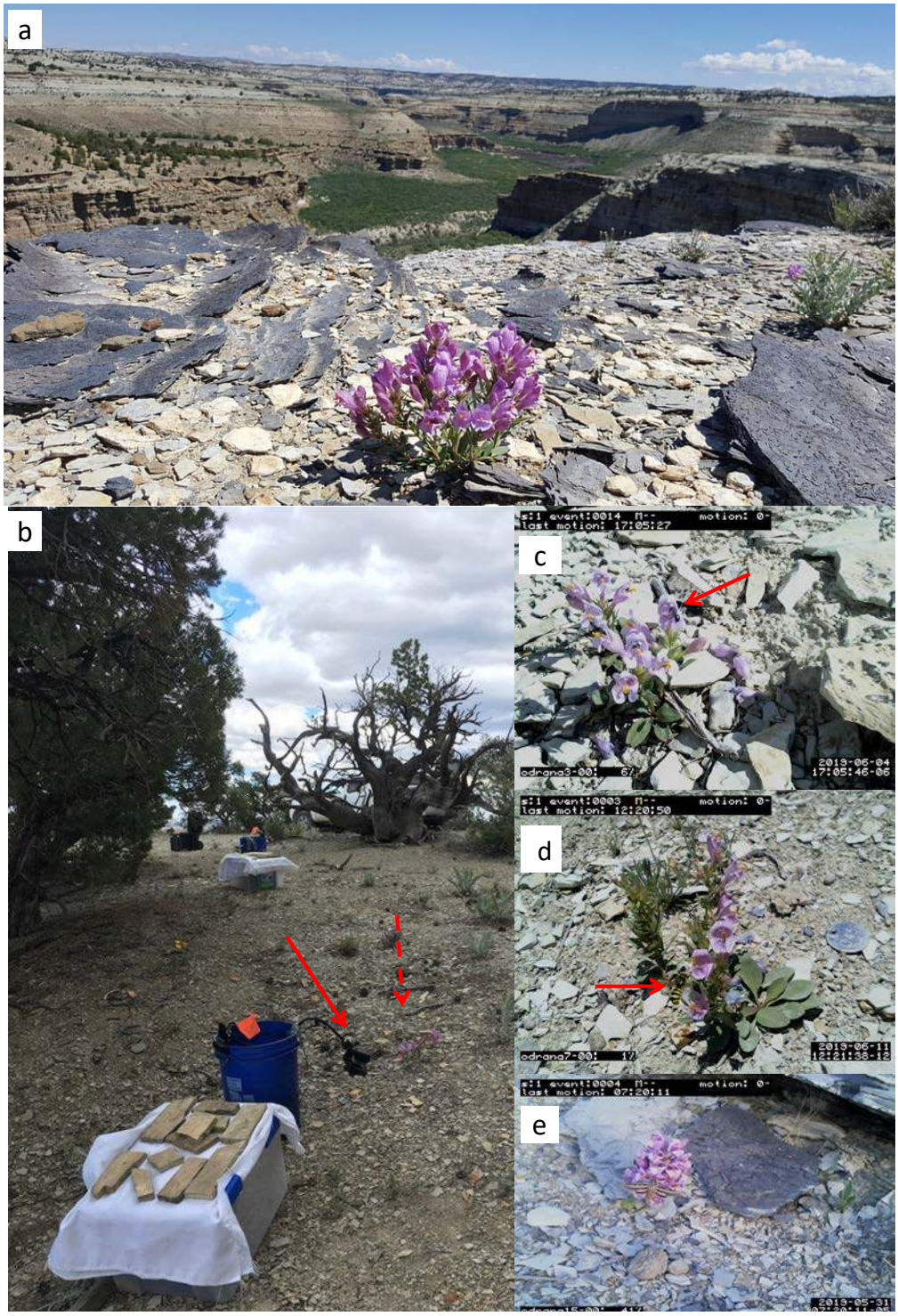

Fig. 2. Landscape-scale pollinator monitoring of *Penstemon grahamii* using Rana: a) landscape view of the DWR3 study site; b) site view of three Rana units monitoring pollinator visitation at the Blue Knoll East site. A unit consists of a data logger and battery (housed in weatherproof box) and a camera (solid line) trained on a monitored plant (compound arrow). Examples of pollinators visiting *P. grahamii* flowers captured by Rana: c) *Osmia* bee, d) female *Pseudomasaris vespoides* (pollen wasp), and e) *Hyles lineata* (striped-sphinx hawkmoth).

7.3 *Sonication*

During the 2018 field work, we noticed the distinct buzzing sound that *Osmia* bees make while visiting PENALB flowers. From these observations, we hypothesized that these bees sonicate (buzz pollinate) flowers. To test our hypothesis, in 2019, we revisited PENALB sites, in addition to PENGRA sites, and recorded the sound of bees visiting flowers using a standard audio recorder (as described by Cane in [8]). For comparative purposes, we also recorded the sounds of anther rasping by pollen wasps at PENALB and PENGRA flowers in the field, and sonicating bumblebees visiting *Penstemon* and tomato flowers in the grounds of RBG. Analysis of sound data (sonograms) is underway. This information is important for describing the pollination mechanism of the plant species and the degree of specialization in the plant-pollinator mutualism.

7.4 *Plant community composition, floral display and population density*

During peak PENGRA flowering at each site, we surveyed the plant community and floral display within four 25 x 2 m transects located within representative habitat occupied by the majority of PENGRA individuals in each population. In each transect, we recorded the identity and density of all plant species and the number of flowering units per flowering individual. A floral unit being one that a medium-sized bee has to fly, rather than walk, between (a method used by [9]); for example, 1 PENALB flower = 1 floral unit; 1 *Cirsium* capitulum = 1 floral unit. Plant vouchers are stored at RBG.

These data indicate “pollinator attractiveness” at the local site scale during the PENGRA flowering period. Co-flowering species that share pollinators with PENGRA may have a facilitative, competitive or neutral effect on PVR to PENGRA. In addition, we mapped and surveyed the PENGRA and PENALB population distribution and density at all sites. The direct and indirect relationships between these metrics will be examined using Structural Equation Modelling (see section 8 on pg. 8).

7.5 *Fruit and seed collections and processing*

Fruits ripened in mid-July, approximately 4 weeks after flower dehiscence. All fruiting stems were collected from Rana-monitored plants and from additional plants to increase sample size (total, n = 103 individuals: BC, n = 20; BKE, n = 12; DWR, n = 21; DWR3, n = 27; HOL, n = 23). For small populations, all available fruiting plants were collected. To account for variation in ripening times, some plants were bagged with horticultural fleece (AgFabric) to prevent substantial seed loss *in situ*. Fruits belonging to individual plants were collected in paper bags and stored at RBG (warm, ambient temperatures and humidity) while awaiting analysis. The numbers of developed and undeveloped fruits per plant were counted to calculate fruit production. The total numbers of seeds per plant were counted and mean seeds per fruit was calculated. In total, ~20,500 PENGRA seeds are stored in controlled conditions at RBG pooled by site. This dataset will be incorporated into Structural Equation Models (see section 8 on pg. 8)

7.6 *Defining and Quantifying Disturbance factors*

In order to test the overarching study hypotheses, we have a built a pairwise individual-based database of disturbance-related, landscape-scale metrics associated with individual plants from all PENALB and PENGRA study populations. Variables include distance to roads and well pads, PENGRA/PENALB population density, and density of road networks within buffer zones radiating out from focal plants at spatial scales biologically relevant to the likely foraging ranges of the known principal pollinators. The use of this dataset will be informed by our analytical approach using SEM (see section 8 below).

8. Structural Equation Modelling

Structural Equation Modelling (SEM) is one of the fastest growing and more flexible statistical techniques in ecology and provides a new way to explore and quantify ecological systems [4,10]. Broadly, SEM unites multiple variables in a causal network and, because variables can be both predictors and responses (unlike conventional linear models), SEM will quantify both direct and indirect (cascading) effects. SEM output is illustrated as box-and-arrow diagrams showing the directed (causal) pathways between variables and the relative strength of those relationships (Fig. 3). For example, we may reasonably hypothesize that *Penstemon* population size predicts pollinator visitation rates (PVR) because large populations with showy floral displays are more attractive to pollinators. We may also predict that PVR is a predictor of fruit production and seed set. In the first example, PVR is the response variable, and in the second example, it is a predictor variable. We must also consider that population size may have an indirect effect on fruit and seed production via a direct effect on PVR and/or due to unknown/unquantified variables related to competition for resources (i.e. 'missing pathways'). In reality, nature is complicated and there are extraneous influences contributing to a response [4]. For the *Penstemon* systems, there are many variables and causal pathways to consider, for example, distance to roads may indirectly effect PVR via a direct effect on population size and community-level floral display (Fig. 3). The beauty of SEM is in unravelling complexity within ecological systems and

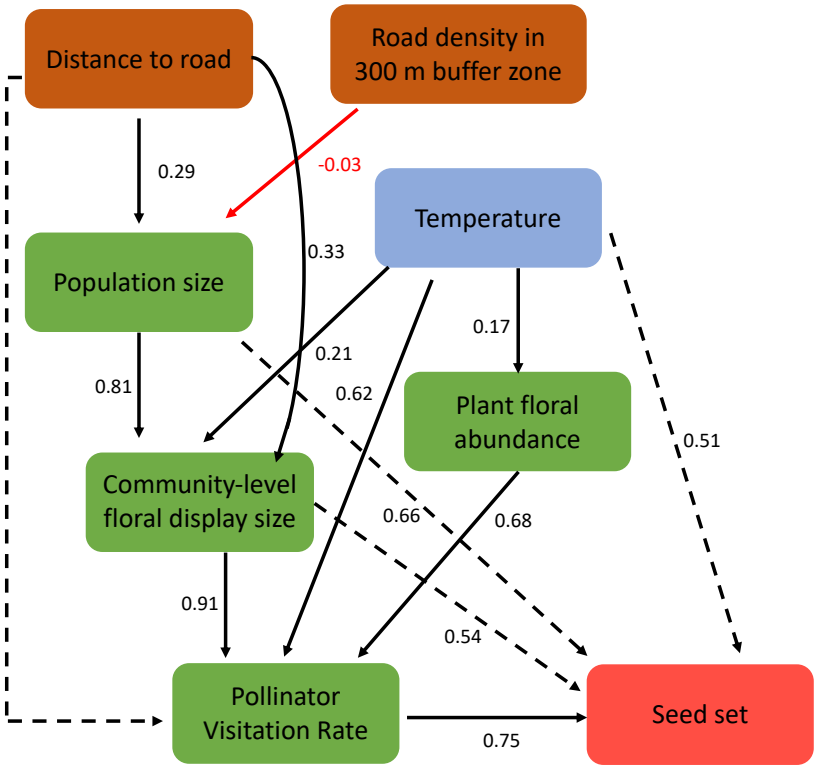

Fig. 3. A conceptual, simplified example of what a SEM diagram could look like in this study.

delivering useful information that can be applied to conservation management. For example, if population size is found to be a critical path affecting population fecundity then restoration efforts would be best targeted at small populations. Similarly, if distance to roads is identified as a causal path, threshold buffer zones can be determined for the purpose of designing effective reserves.

References

1. Barlow SE, Wright GA, Ma C, Barberis M, Farrell IW, Marr EC, Brankin A, Pavlik BM, Stevenson PC: **Distasteful Nectar Deters Floral Robbery**. *Curr Biol* 2017, **27**:2552-2558.e3.
2. Pavlik BM, Barlow SE: **Using Rana to screen plant species for effective pollinator support during ecosystem restoration. I. Pilot study at Rio Mesa and Red Butte Garden.** 2016, doi:10.13140/RG.2.2.15709.92643.
3. Barlow SE, Pavlik BM: **Estimating the Spatial Dimensions of Astragalus holmgreniorum Mutualisms . Pollinator Visitation and Behaviors Along a Seed Set Gradient**. 2017,
4. Lefcheck JS: **piecewiseSEM: Piecewise structural equation modelling in r for ecology, evolution, and systematics**. *Methods Ecol Evol* 2016, **7**:573–579.
5. McCaffery RM, Reisor R, Irvine K, Brunson J: **Demographic monitoring and population viability analysis of two rare beardtongues from the Uinta Basin**. *West North Am Nat* 2014, **74**:257–274.
6. Hornbeck JH: **White River Beardtongue (Penstemon albifluvis) Reproductive Success 2017 Pilot Study Report. Manzita Botanical Consulting, Salt Lake City, Utah**. 2018,
7. Simonyan K, Zisserman A: **Very Deep Convolutional Networks for Large-Scale Image Recognition**. In *ICLR*. . 2015:1–14.
8. Cane JH: **The oligolectic bee Osmia brevis sonicates Penstemon flowers for pollen: a newly documented behavior for the Megachilidae**. *Apidologie* 2014, **45**:678–684.
9. Dicks L V, Corbet SA, Pywell RF: **Compartmentalization in plant-insect flower visitor webs**. *J Anim Ecol* 2002, **71**:32–43.
10. Elmhagen B, Rushton SP: **Trophic control of mesopredators in terrestrial ecosystems: Top-down or bottom-up?** *Ecol Lett* 2007, **10**:197–206.

Appendix D

Penstemon Monitoring Plots and BLM AIM Plot Locations

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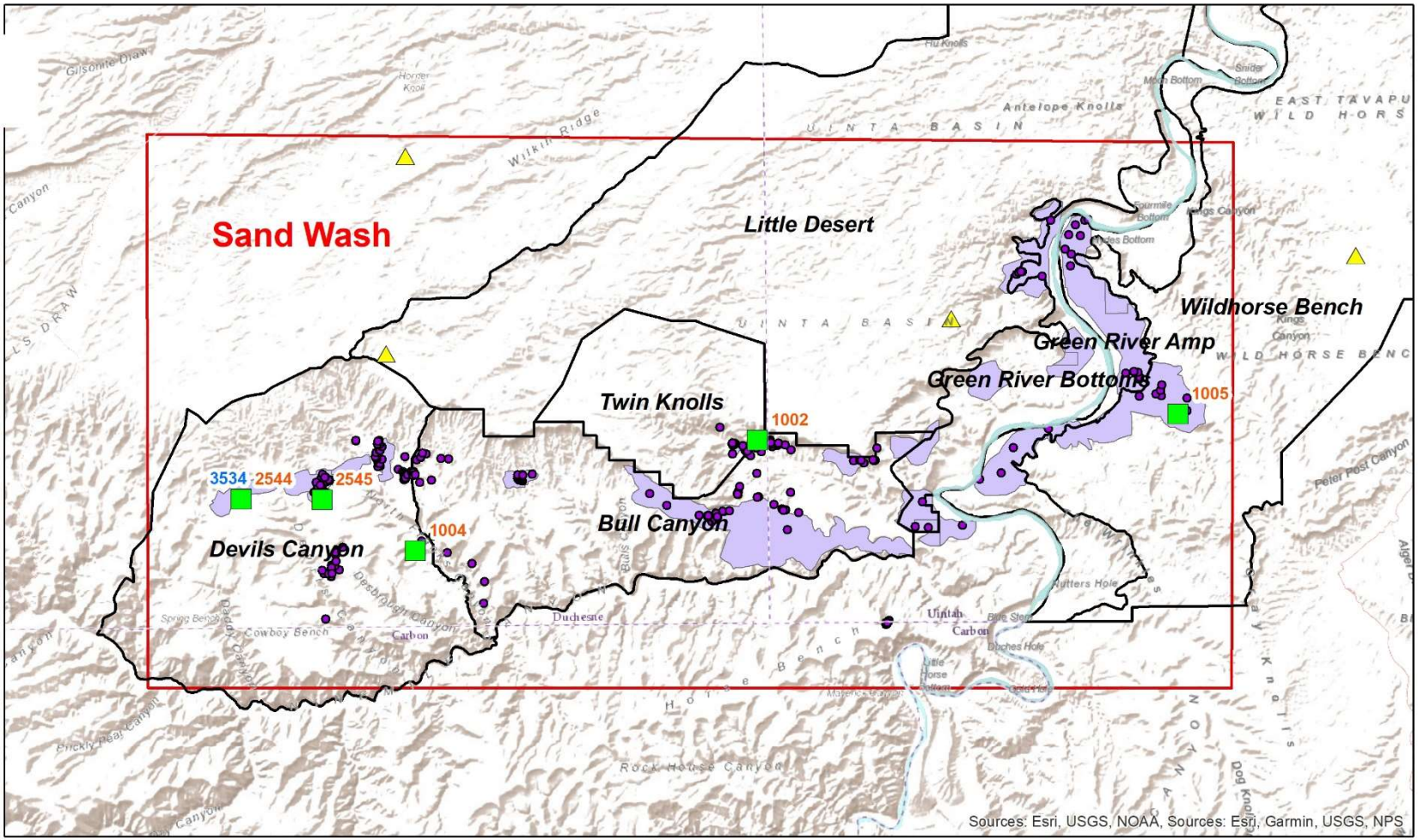

Legend

Penstemon Observations

- Penstemon grahamii
- Penstemon scariosus var. albifluvis

Penstemon Monitoring Plots

- Penstemon Monitoring Plot
- ### Plots with iButtons
- AIM Plots

- *Livestock Allotments*
- Penstemon Units
- Penstemon Conservation Areas

Penstemon Monitoring Plots and BLM AIM Plots Sand Wash Unit

Penstemon Conservation Team

0 1 2 4 Miles

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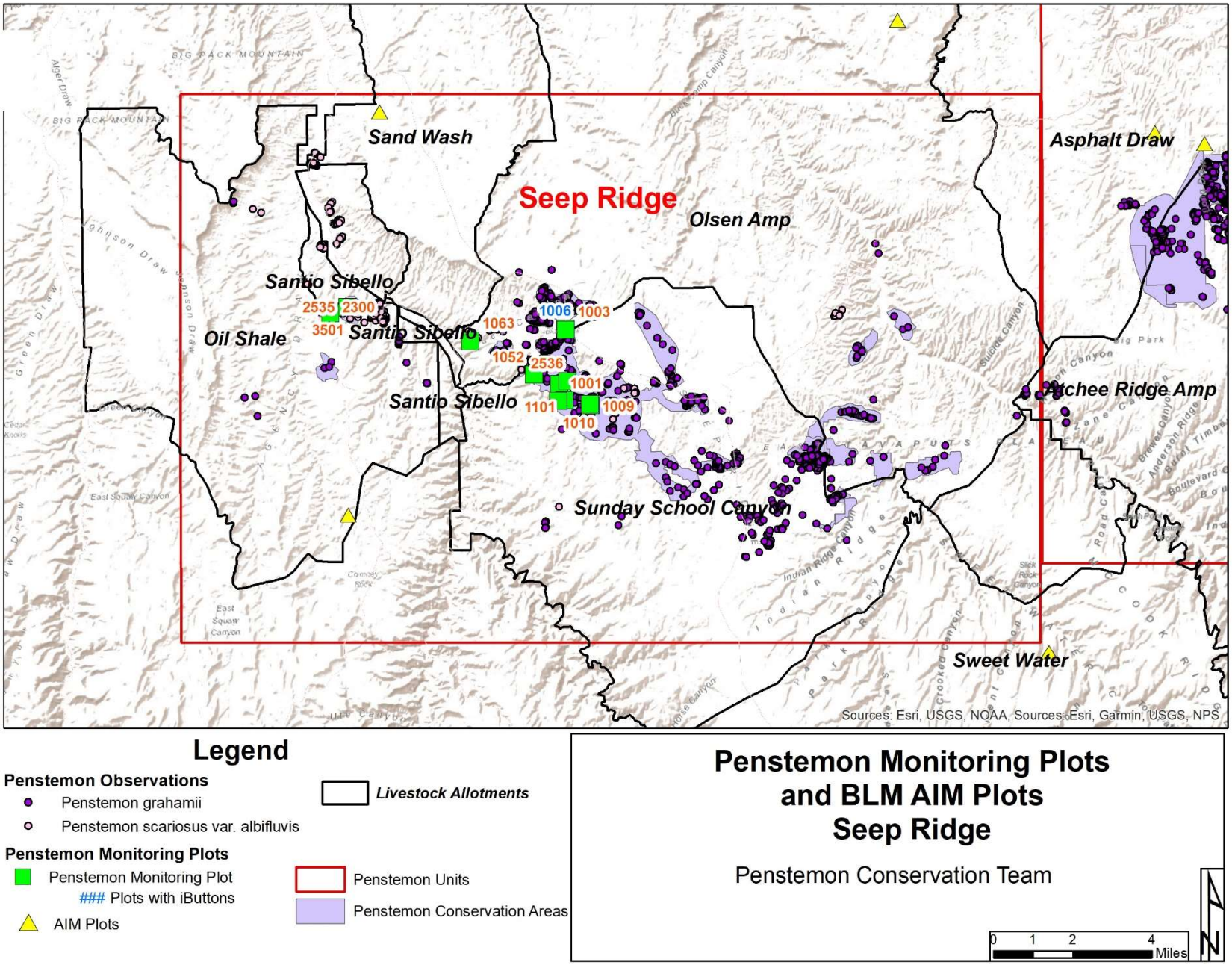
Sand Wash
Seep Ridge
Olsen Amp
Asphalt Draw
Santio Sibello
Oil Shale
Santio Sibello
Santio Sibello
Atchee Ridge Amp
Sunday School Canyon
Sweet Water
2535
2300
3501
1063
1006
1003
1052
2536
1001
1101
1009
1010
Sources: Esri, USGS, NOAA, Sources: Esri, Garmin, USGS, NPS
Legend
Penstemon Observations
Penstemon grahamii
Penstemon scariosus var. albifluvis
Penstemon Monitoring Plots
Penstemon Monitoring Plot
Plots with iButtons
AIM Plots
Livestock Allotments
Penstemon Units
Penstemon Conservation Areas
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and BLM AIM Plots
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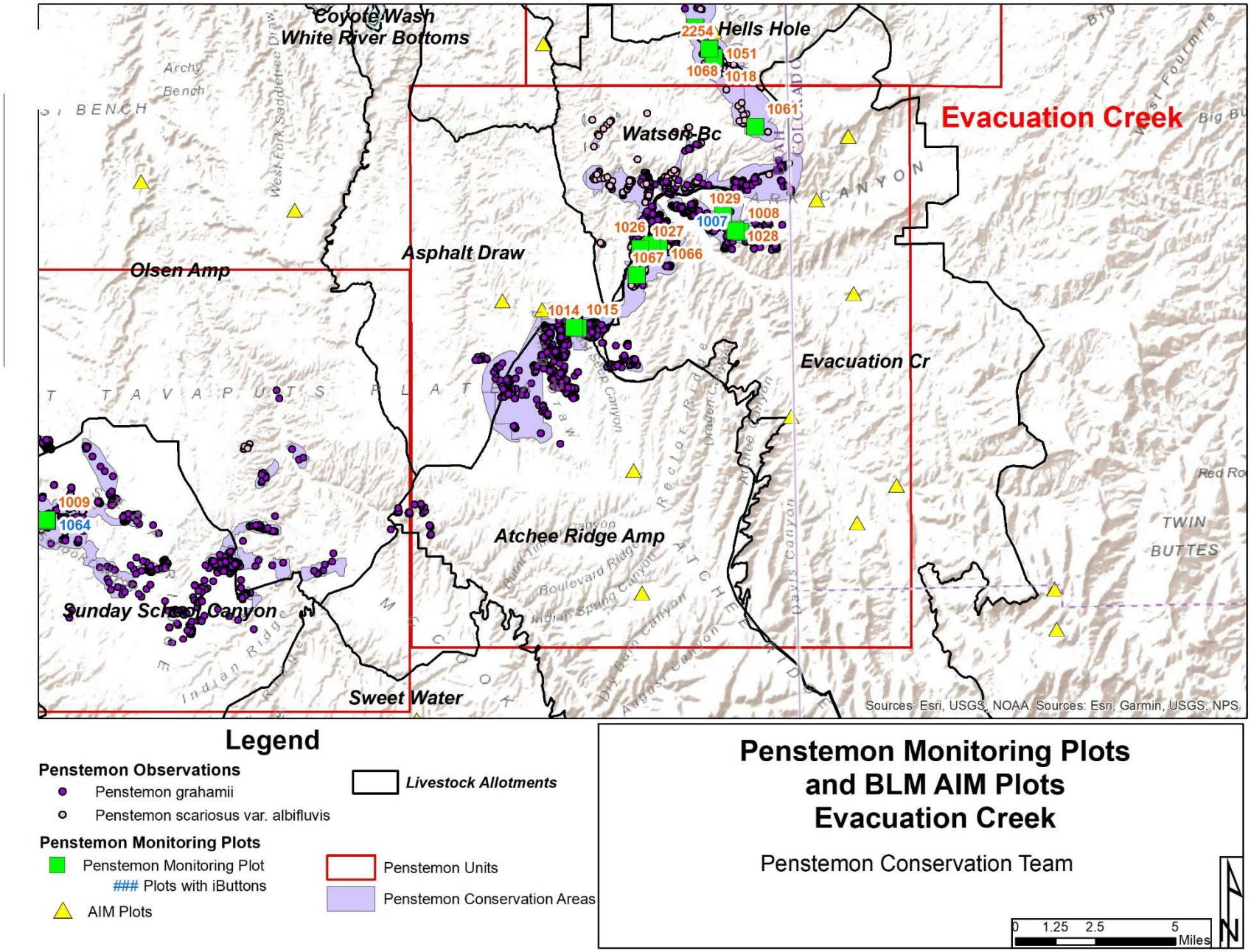
Coyote Wash
White River Bottoms
Hells Hole
2254
1051
1068
1018
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Evacuation Creek
Watson Bc
1029
1008
1007
1026
1027
1028
1067
1066
Asphalt Draw
Olsen Amp
1014
1015
Evacuation Cr
1009
1064
Atchee Ridge Amp
Sunday School Canyon
Sweet Water
TWIN BUTTES
Sources: Esri, USGS, NOAA, Sources: Esri, Garmin, USGS, NPS
Legend
Penstemon Observations
Penstemon grahamii
Penstemon scariosus var. albifluvis
Penstemon Monitoring Plots
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Plots with iButtons
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Livestock Allotments
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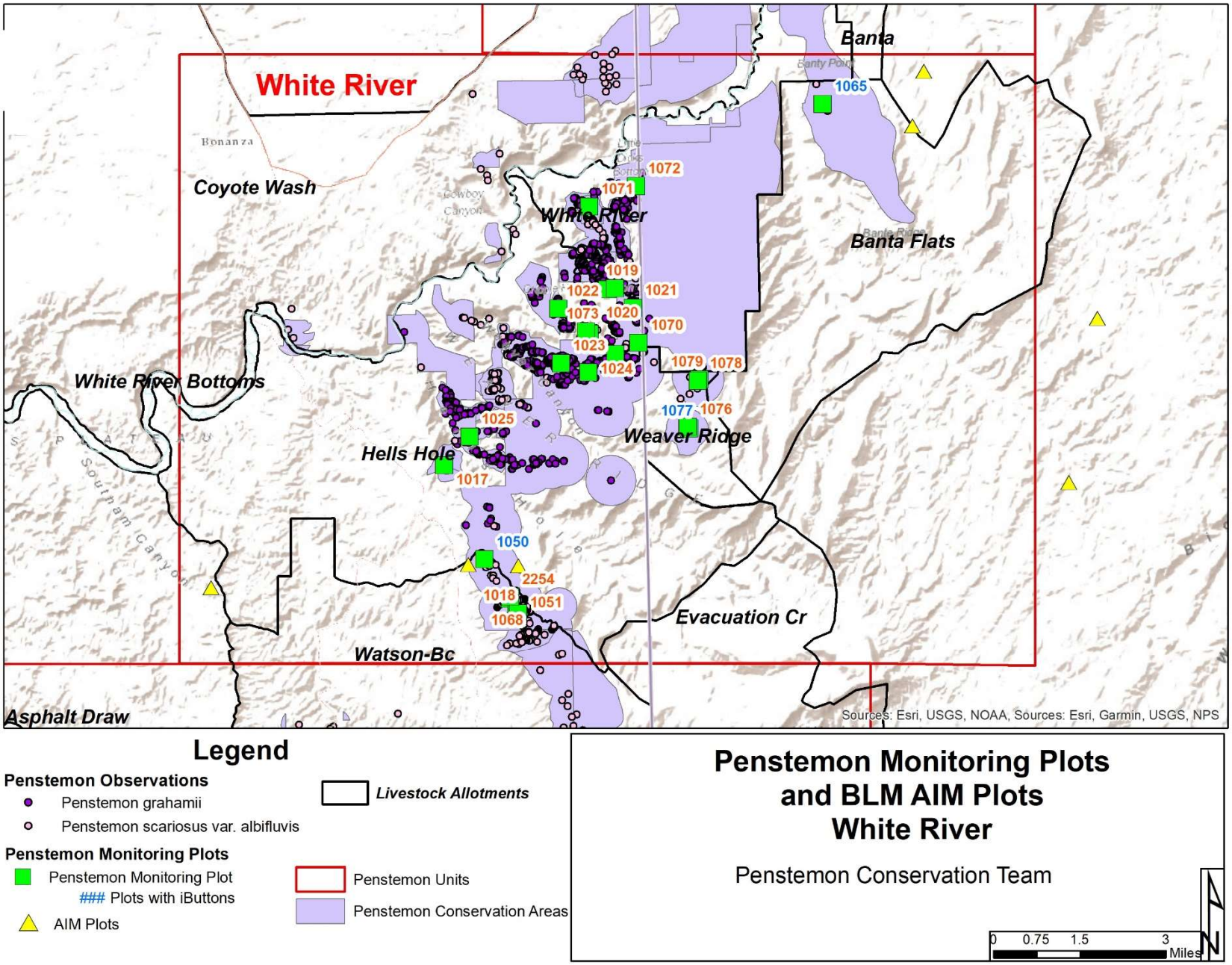
White River
Bonanza
Coyote Wash
Cowboy Canyon
White River
Banta
Banty Point
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Banta Flats
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1019
1022
1021
1073
1020
1070
1023
1024
1079
1078
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1076
Weaver Ridge
White River Bottoms
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Hells Hole
1017
Southam Canyon
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2254
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Evacuation Cr
Watson-Bc
Asphalt Draw
Sources: Esri, USGS, NOAA, Sources: Esri, Garmin, USGS, NPS
Legend
Penstemon Observations
Penstemon grahamii
Penstemon scariosus var. albifluvis
Penstemon Monitoring Plots
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Plots with iButtons
AIM Plots
Livestock Allotments
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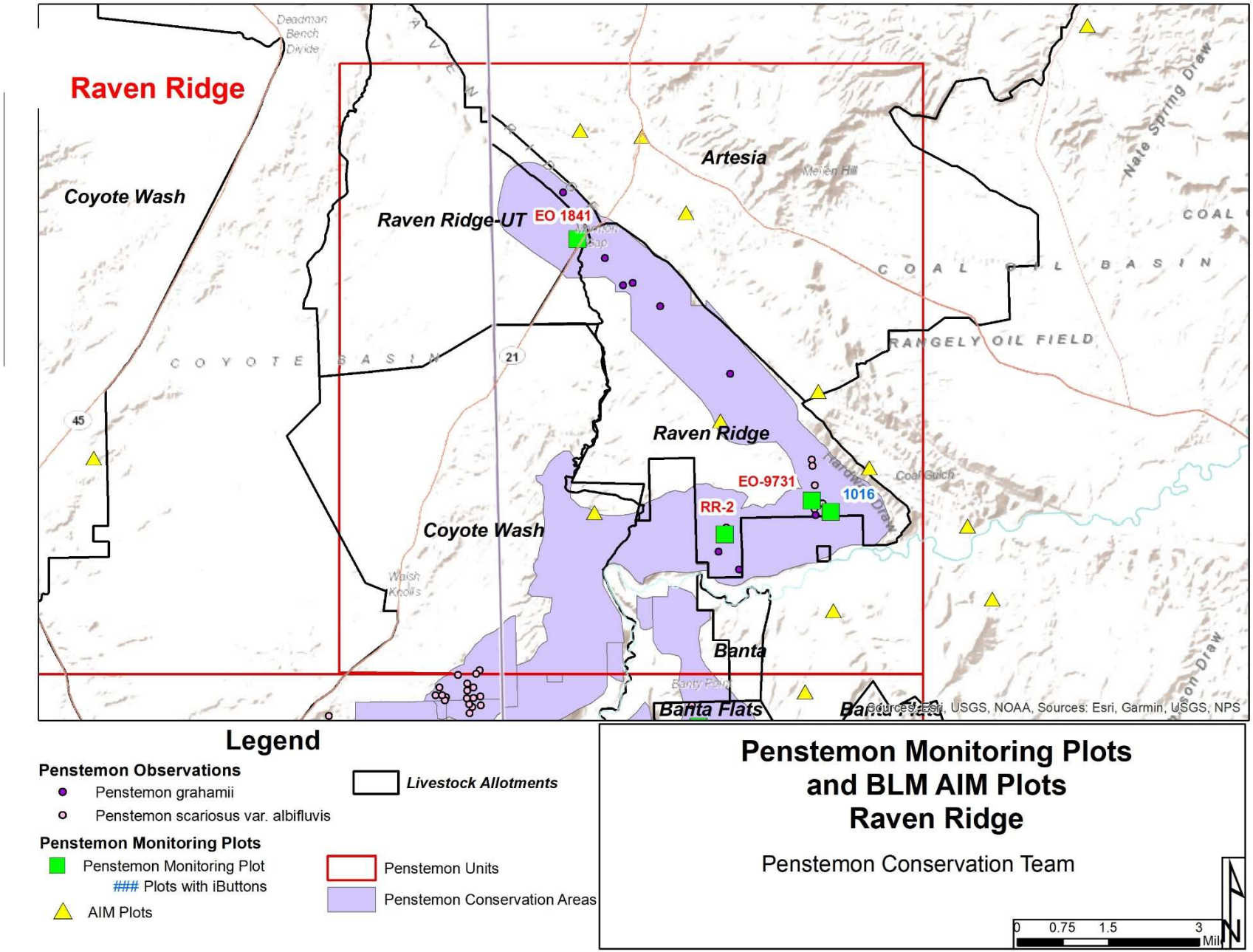
Raven Ridge
Coyote Wash
Raven Ridge-UT
EO 1841
Artesia
Meiers Hill
Nate Spring Draw
COAL
COAL BASIN
RANGELY OIL FIELD
COYOTE BASIN
21
45
Raven Ridge
EO-9731
1016
RR-2
Coal Gulch
Hardscrabble Draw
Coyote Wash
Walsh Knolls
Banta
Banty Point
Banta Flats
Barcus Flats
Sources: Esri, USGS, NOAA, Sources: Esri, Garmin, USGS, NPS
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Penstemon Observations
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Appendix E

BLM Colorado State Office 2019 Graham's and White River Population Monitoring Report

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Bureau of Land Management
U.S. Department of the Interior

Graham's Beardtongue and White River Beardtongue (*Penstemon grahamii* and *Penstemon scariosus* var. *albifluvis*)

BLM – Colorado 2019 Summary of Accomplishments / Activities

Exposed Green River oil shale near Rangely, CO; habitat for both beardtongue species. Photo: Phil Krening

Produced by: Phillip Krening
Plant Conservation Specialist
BLM – Colorado State Office

Summary –

Annual survey and monitoring activities for both Graham's and White River beardtongue were completed by the BLM – Colorado State Office with the help of White River Field Office staff during early July of 2019. Sites monitored included the single, long-term Graham's beardtongue study site in Colorado at Mormon Gap, and the three White River beardtongue study sites established between 2017 and 2018. Several previously mapped Graham's beardtongue occurrences were revisited within the Raven Ridge ACEC as part of an ongoing effort to expand monitoring of suitable populations on BLM managed lands in Colorado. No new trend monitoring sites were established in 2019.

Researchers from the University of Northern Colorado (UNC) joined BLM staff in the field to collect leaf tissue from both species to be used in phylogenetic analysis.

Trend Monitoring –

BLM – Colorado has been monitoring Graham's beardtongue at Mormon Gap in the Raven Ridge ACEC since the mid 1980's; representing the longest running known study of the species. Following the implementation of the Conservation Agreement and Strategy for Graham's Beardtongue (*Penstemon grahamii*) and White River Beardtongue (*Penstemon scariosus* var. *albifluvis*) (the "strategy") in 2014, BLM – Colorado has worked to expand monitoring of both beardtongue species in the state. Since 2016, three long-term monitoring study sites have been established at White River beardtongue occurrences in Conservation Units 4 and 5 (Figure 15). Occurrences of Graham's beardtongue continue to be assessed for their suitability for sampling. To date, no additional suitable populations have been identified on BLM managed lands in Colorado.

2019	PEGRA Mormon Gap	PESCA Raven Ridge 1	PESCA Raven Ridge 2	PESCA Weaver Canyon
UTM	12T 668285-4445689	12T 674485-4438801	12T 672187-4437912	12S 667700-4423842
Date Established with Sample Size	2009	2017	N/A	N/A
Macroplot area (m^2)	700	800	800	720
Transects (m)	15 (1x35m)	12 (1x20m)	12 (1x20m)	12 (1x20m)
Est. plant total in 2019	63	523	400	437
% reproductive	28%	52%	81%	87%
Significant increase or decrease in 2019 since initiation	sig. decrease	sig. increase	sig. decrease	sig. decrease
p	0.05	0.01	< 0.01	< 0.01
Mean density 2019 (plants/m^2)	0.09	0.65	0.50	0.55

Table 1. Summary statistics for the four PEGRA and PESCA monitoring sites.

PEGRA Mormon Gap –

The Mormon Gap study site has been the focus of Graham's beardtongue monitoring by the BLM since the mid 1980's. The current monitoring framework was established in 2005 and consists of a single large, rectangular macroplot that encompasses the core of the population. Fifteen randomly placed 1 x 35 meter belt transects within the macroplot allow us to make inferences to population size and trend (*i.e.* the change in mean plant density) at the site over time. This year's data marked the eleventh sampling interval during the fifteen year duration of the study.

The Mormon Gap population increased in terms of total number of plants and number of rosettes between 2018 and 2019; despite having experienced a significant decrease in plant density since monitoring was established in 2005. This year had the highest rosette density observed since pre 2014 - when a livestock trailing event significantly impacted the population - a trend that suggests that the population is slowly recovering. Plant density at the site has averaged 0.09 plants / m^2 over the duration of the study; equivalent to about one plant every 10 sq. meters. This average core population density is low, even by rare plant standards, yet remains higher than other Graham's beardtongue occurrences in Colorado, and represents the best known example of the species on public lands in the state.

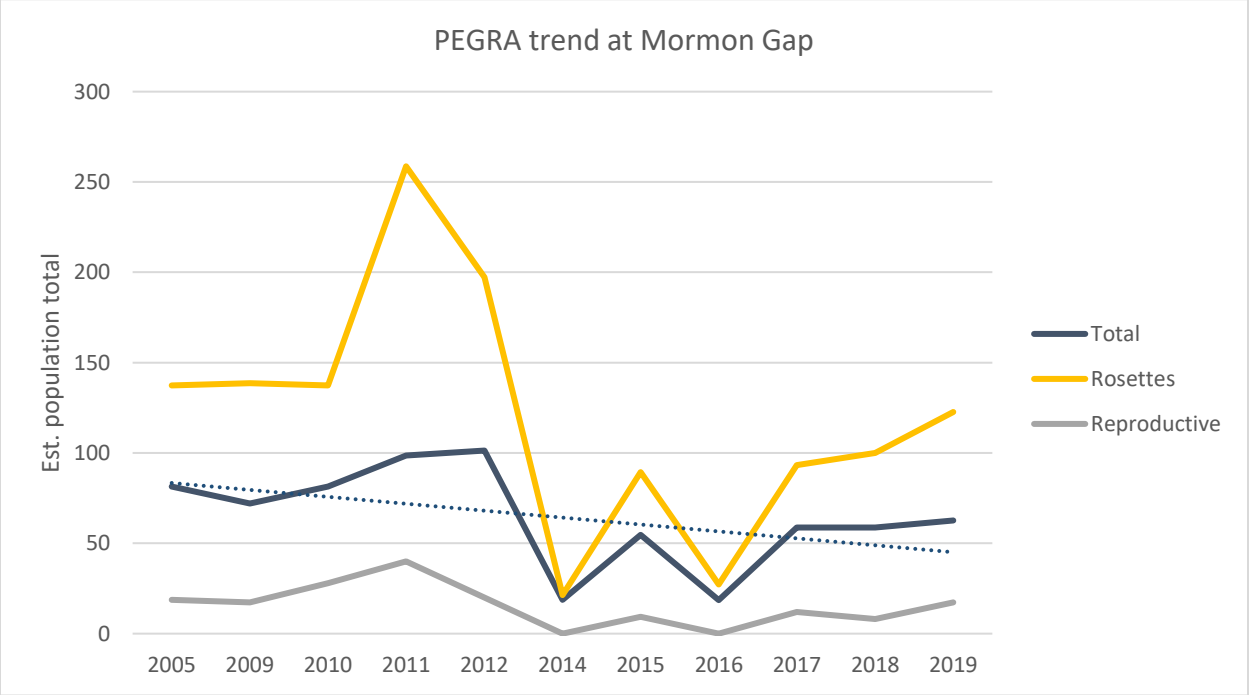

Figure 1. Total, reproductive, and rosette PEGRA trend at Mormon Gap. Trend is defined by the change in the estimated population total between 2005 and 2019.

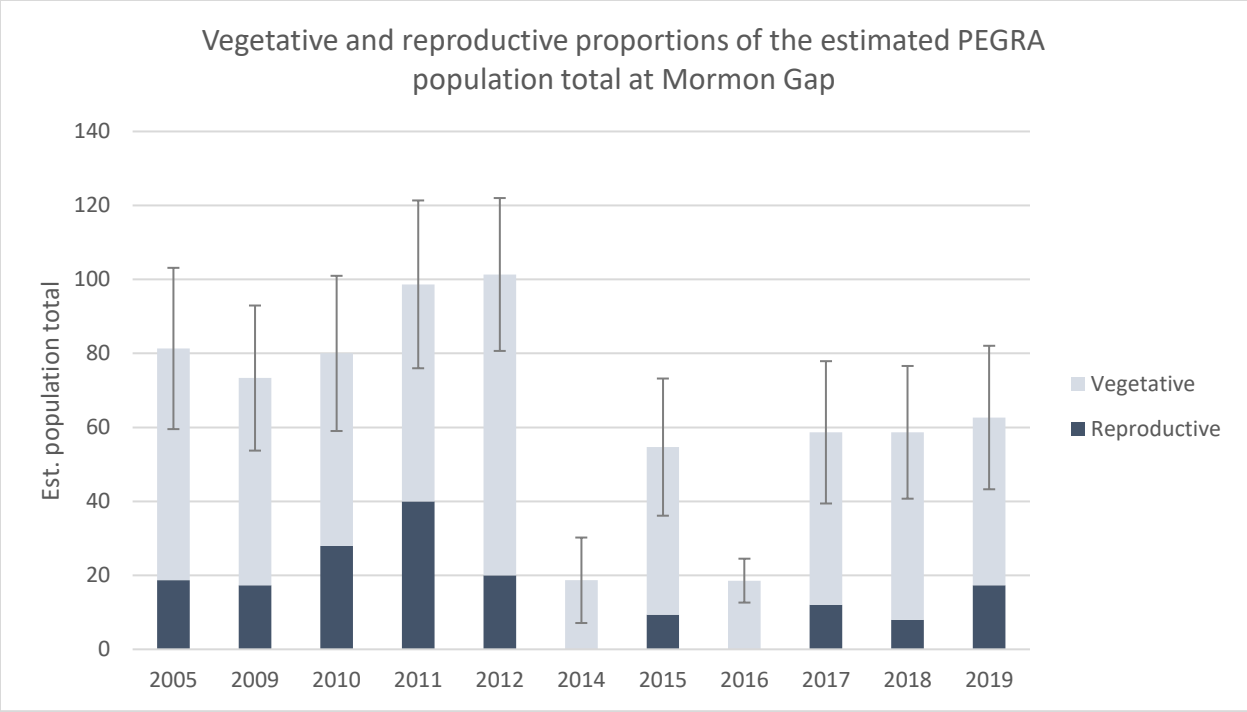

Figure 2. Estimated PEGRA totals per year at Mormon Gap broken down by life stage. 95% confidence interval displayed for the estimated plant total.

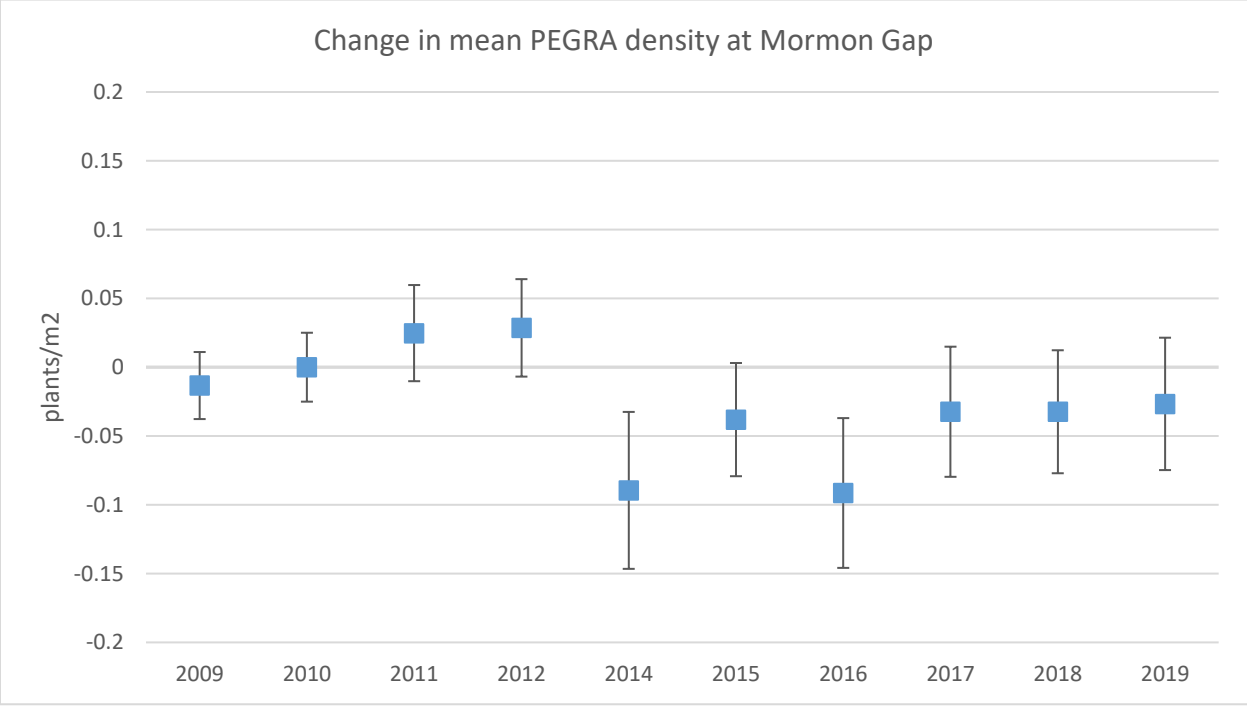

Figure 3. Population change at Mormon Gap as defined by the change in mean PEGRA plant density (plants / m^2) between 2005 and 2019. 95% confidence intervals are displayed on either side of the mean value.

PESCA Monitoring –

Three long-term trend monitoring study sites were established in 2017 and 2018 at discrete occurrences of White River beardtongue in Colorado. Two of the study sites occur in the Raven Ridge Conservation Unit, and ACEC of the same name, and a third study site occurs in the White River Conservation Unit (Figures 15 & 16). Average plant density is very similar among these three sites; ranging from 0.5 – 0.65 plants / m^2 in 2019 (Table 1). The average trend of these three populations decreased slightly between sampling year 2018 and 2019 (Figure 4). This decrease is likely not cause for concern – more years of data will work to clarify population trends which are known to fluctuate naturally. It is important to note that despite the fact that the three White River beardtongue study sites are distributed across a relatively broad geographic region and provide a sense of regional trends, more study sites are required to accurately represent range-wide population trends; likewise, any extrapolation to the landscape or species at large ultimately represents a subjective assessment.

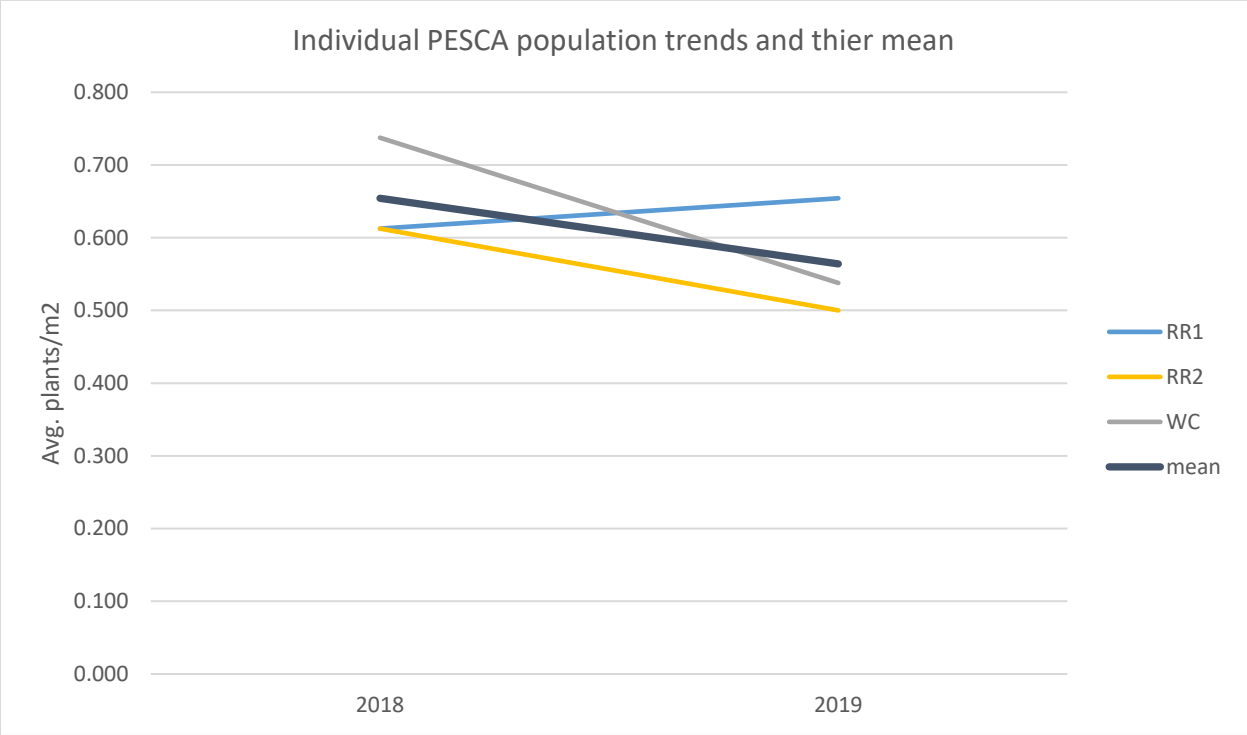

Figure 4. Individual PESCA population trends and their mean (change in avg. plants/m^2).

Raven Ridge 1 –

Population trend at Raven Ridge 1 has increased from 2017 to 2019. Reproductive individuals accounted for 52% of our sample in 2019.

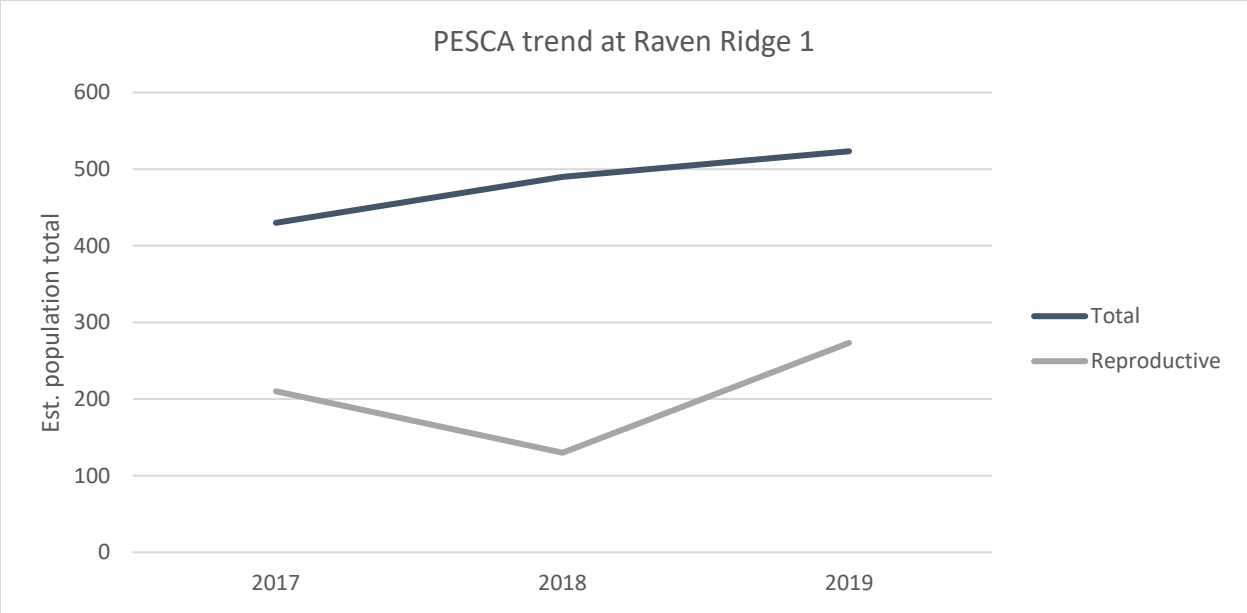

Figure 5. Total and reproductive PESCA trend at Raven Ridge 1. Trend is defined by the change in the estimated population total between 2017 and 2019.

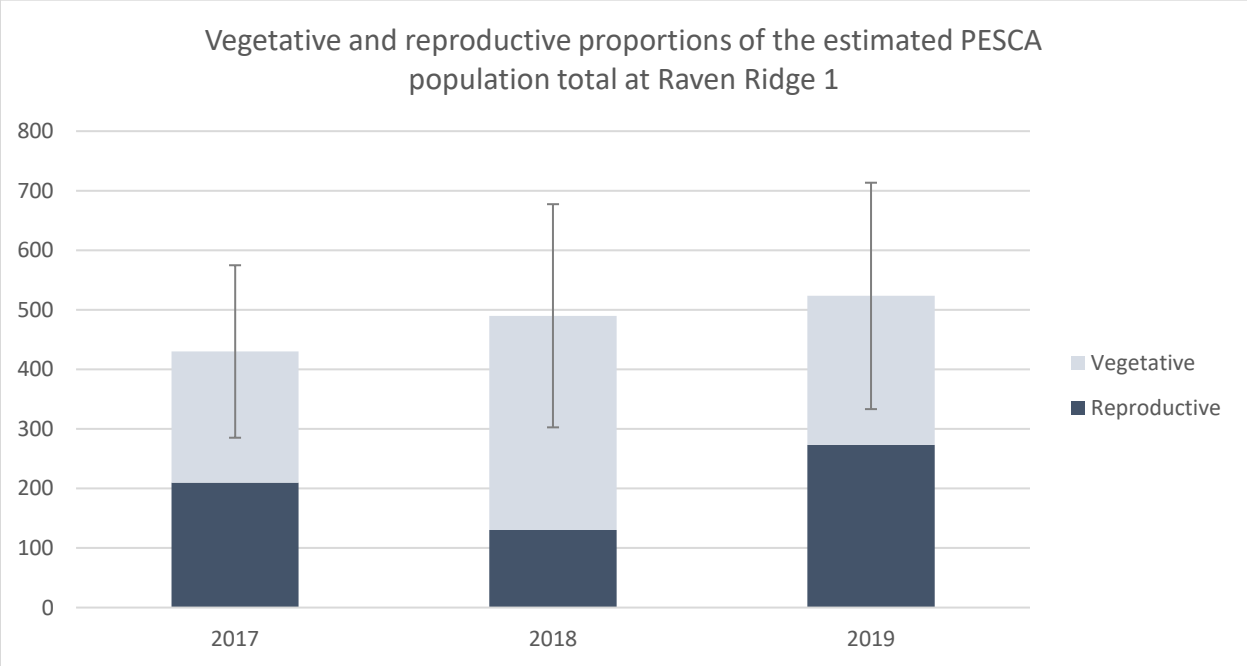

Figure 6. Estimated PESCA totals per year at Raven Ridge 1 broken down by life stage. 95% confidence interval displayed for the estimated plant total.

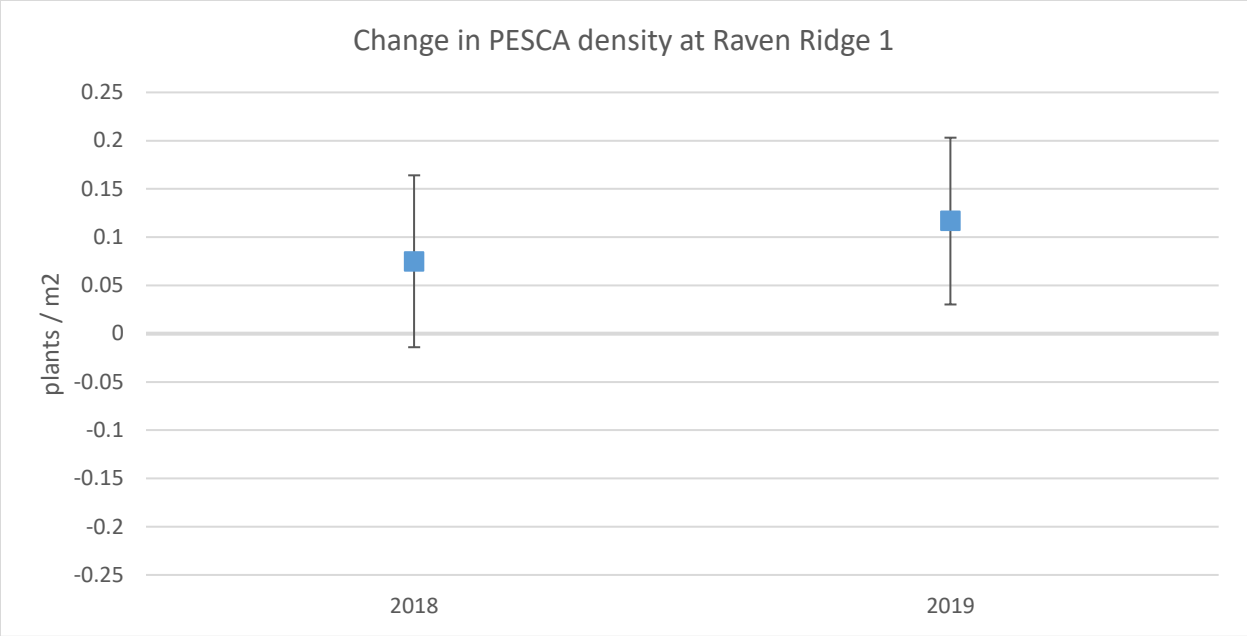

Figure 7. Population change at Raven Ridge 1 as defined by the change in mean PESCA plant density (plants / m^2) between 2017 and 2019. 95% confidence intervals are displayed on either side of the mean value.

Raven Ridge 2 –

Population trend at Raven Ridge 2 decreased between 2018 and 2019. Reproductive frequency increased to 81% of our sample in 2019.

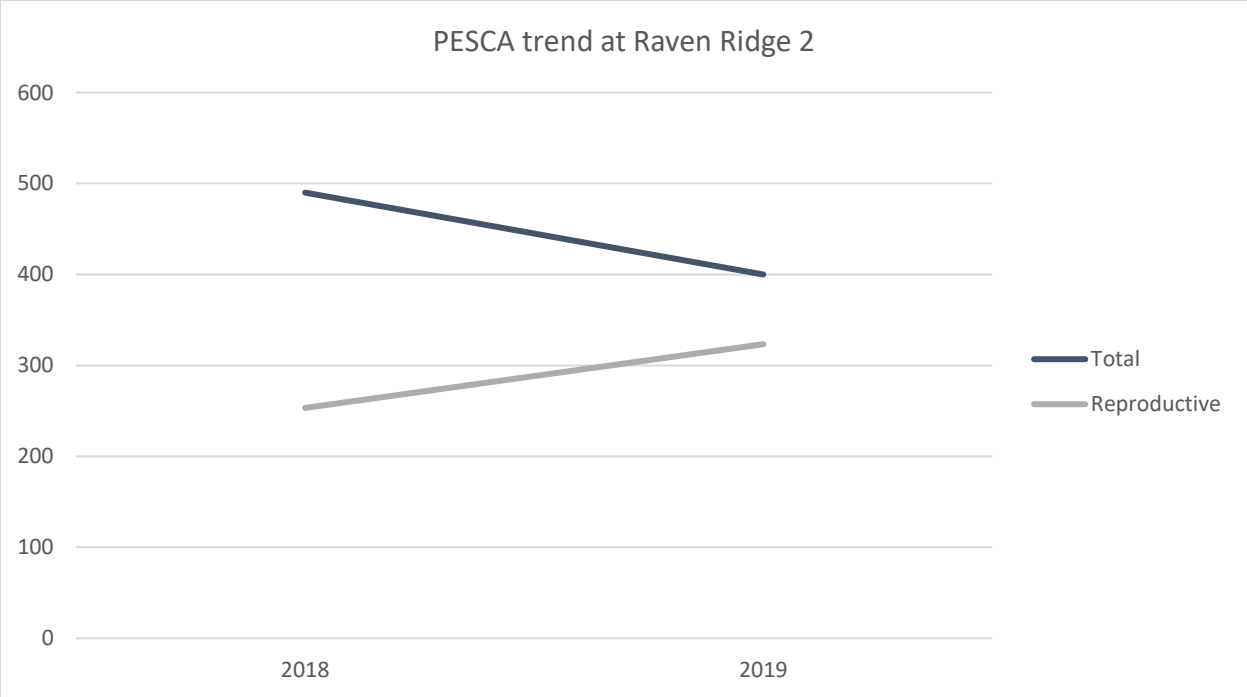

Figure 8. Total and reproductive PESCA trend at Raven Ridge 2. Trend is defined by the change in the estimated population total between 2018 and 2019.

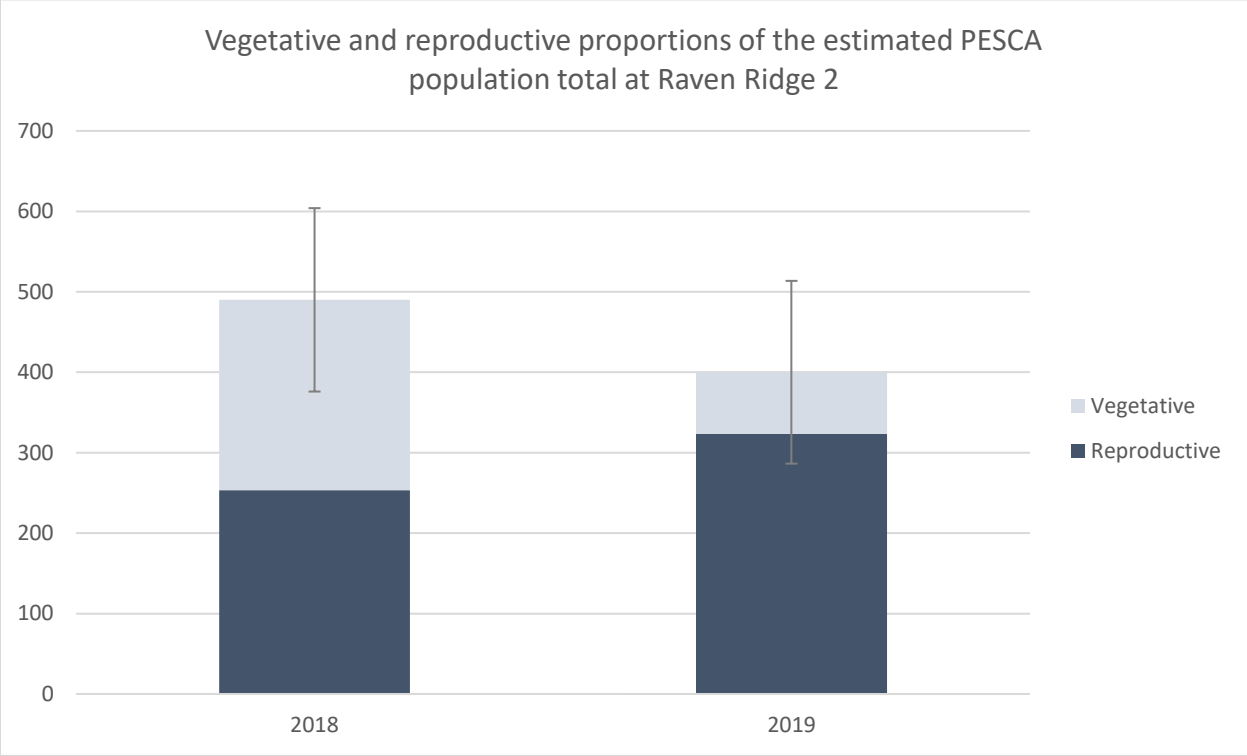

Figure 9. Estimated PESCA totals per year at Raven Ridge 1 broken down by life stage. 95% confidence interval displayed for the estimated plant total.

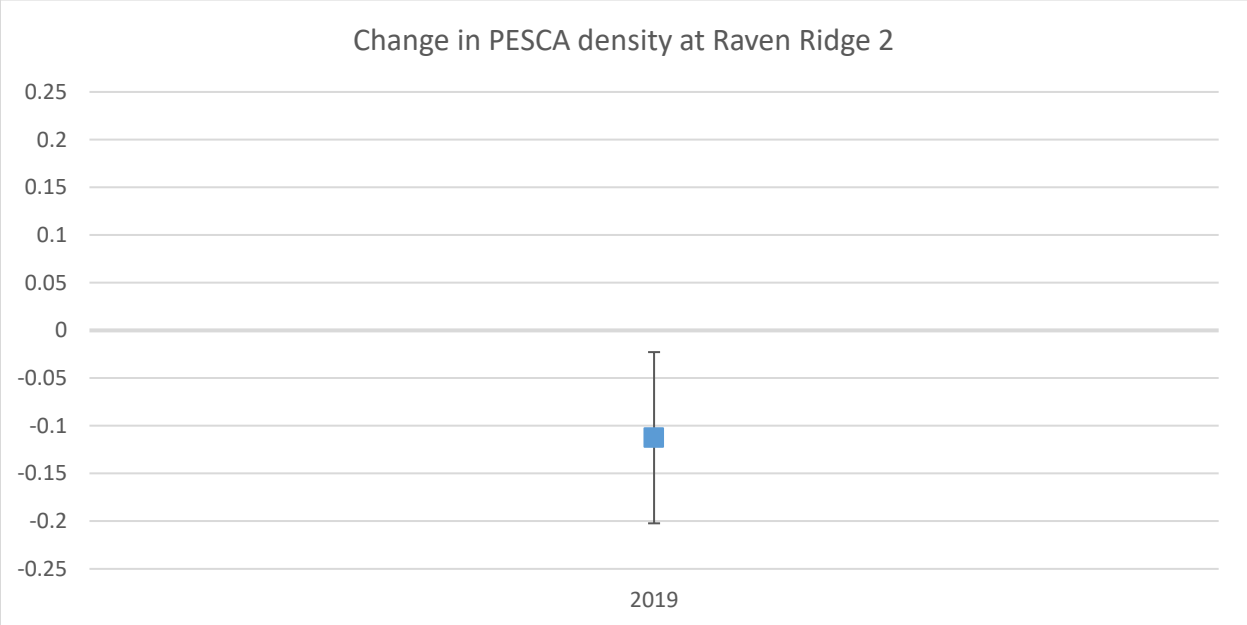

Figure 10. Population change at Raven Ridge 2 as defined by the change in mean PESCA rosette density (rosettes / m^2) between 2018 and 2019. 95% confidence intervals are displayed on either side of the mean value.

Weaver Canyon –

The population trend at Weaver Canyon declined between 2018 and 2019. Reproductive frequency remained high at the site in 2019 – accounting for 89% of our sample.

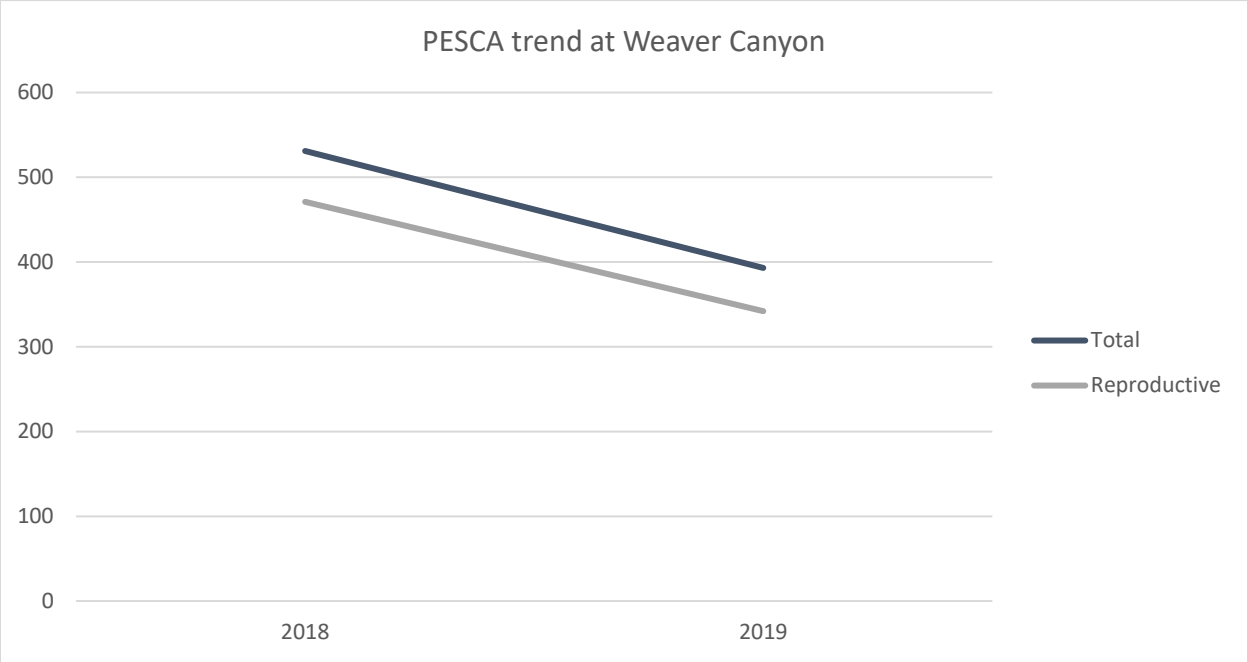

Figure 11. Total and reproductive PESCA trend at Weaver Canyon. Trend is defined by the change in the estimated population total between 2018 and 2019.

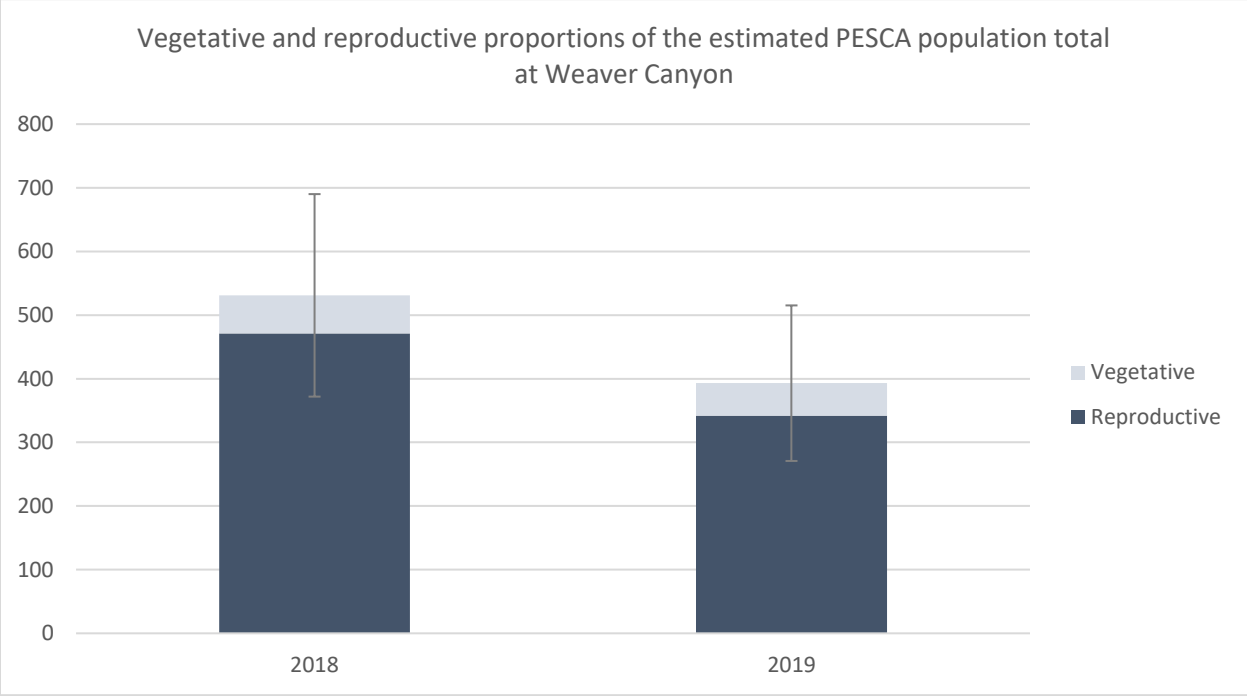

Figure 12. Estimated PESCA totals per year at Raven Ridge 1 broken down by life stage. 95% confidence interval displayed for the estimated plant total.

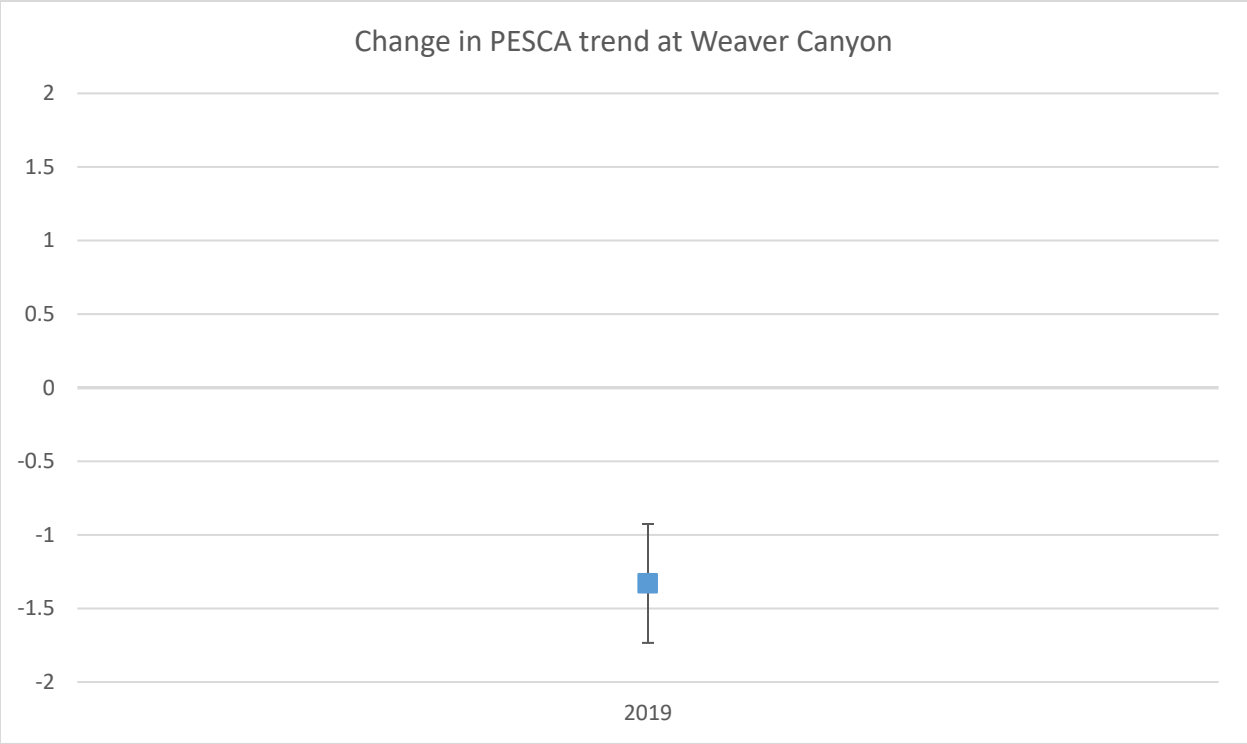

Figure 13. Population change at Weaver Canyon as defined by the change in mean PESCA plant density (plants / m^2) between 2018 and 2019. 95% confidence intervals are displayed on either side of the mean value.

Assessment of existing occurrences –

Two occurrences of Graham's beardtongue were resurveyed in 2019. Both occurrences are located in the Raven Ridge ACEC / Conservation Unit 5 (Figure 14).

- EO 10841 contains the long-term Mormon Gap Graham's beardtongue monitoring site, as well as a significant portion of suitable but unoccupied habitat along Raven Ridge both north and south of County Rd 21. The EO boundary has been contentious based on its generous size.
    - The core population area north of the road was remapped in 2019, constraining the boundary of the EO around occupied habitat. The southern portion of the EO will be reassessed in coming years.
    - The northern portion of EO consists of ca. 100 individual plants.
    - There is a moderate abundance of exotic species inhabiting shale slopes.
- EO 9731 consists of two discrete polygons at the southern end of the Raven Ridge ACEC on bluffs of exposed Green River shale north of the White River.
    - The southern-most polygon was surveyed and re-mapped in 2019, refining the original boundary around occupied habitat.
    - The southern polygon contained approximately 75 individuals distributed at low density over ca. 3 acres.

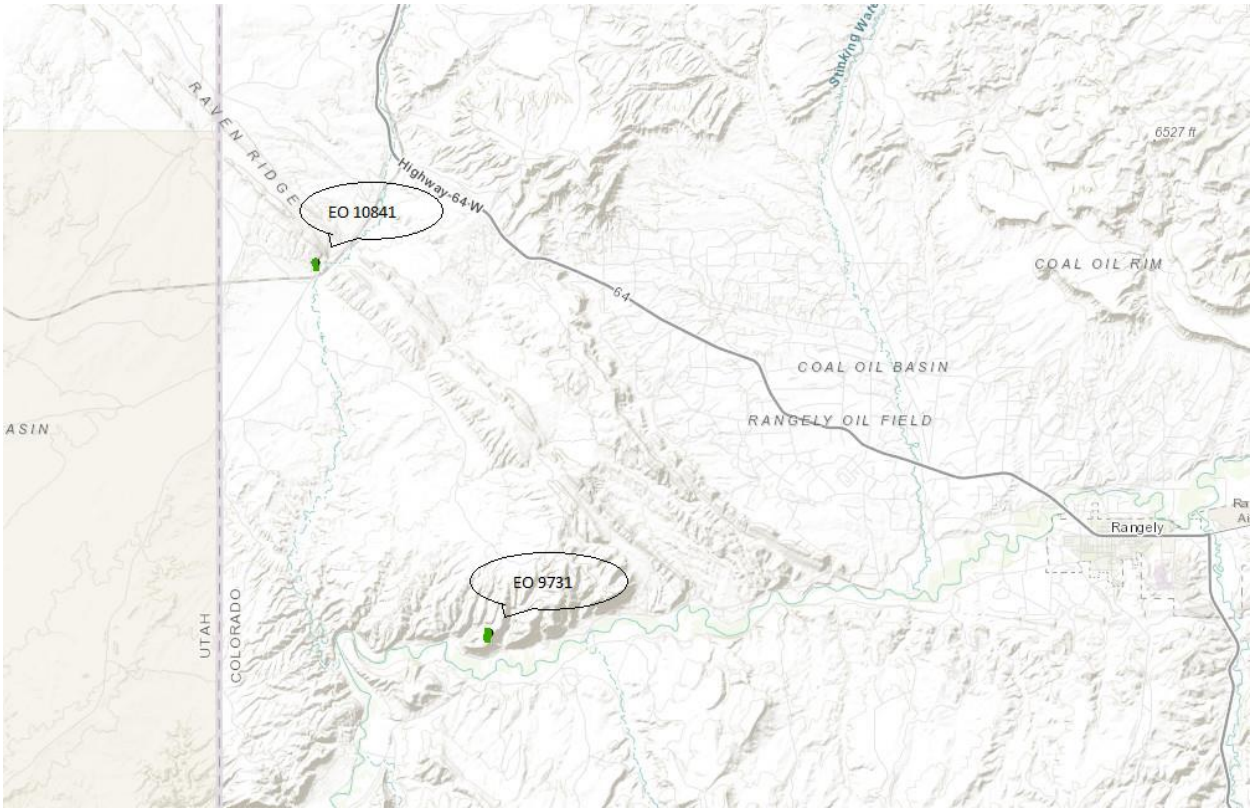

Figure 14. Location of PEGRA EO 10841 and PEGRA EO 9731 in the Raven Ridge ACEC in Colorado

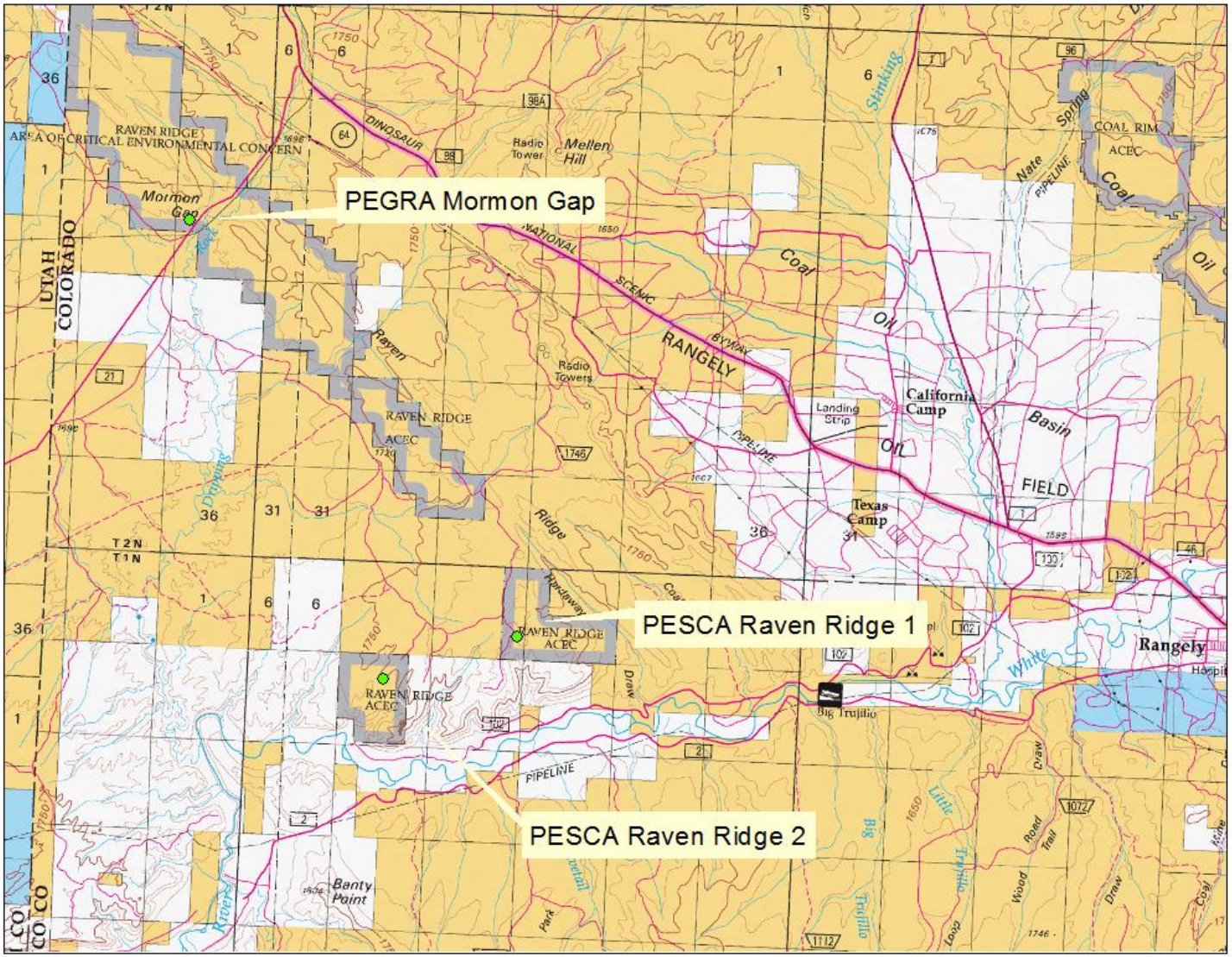

Figure 15. BLM – Colorado monitoring sites in Conservation Unit 5 (Raven Ridge)

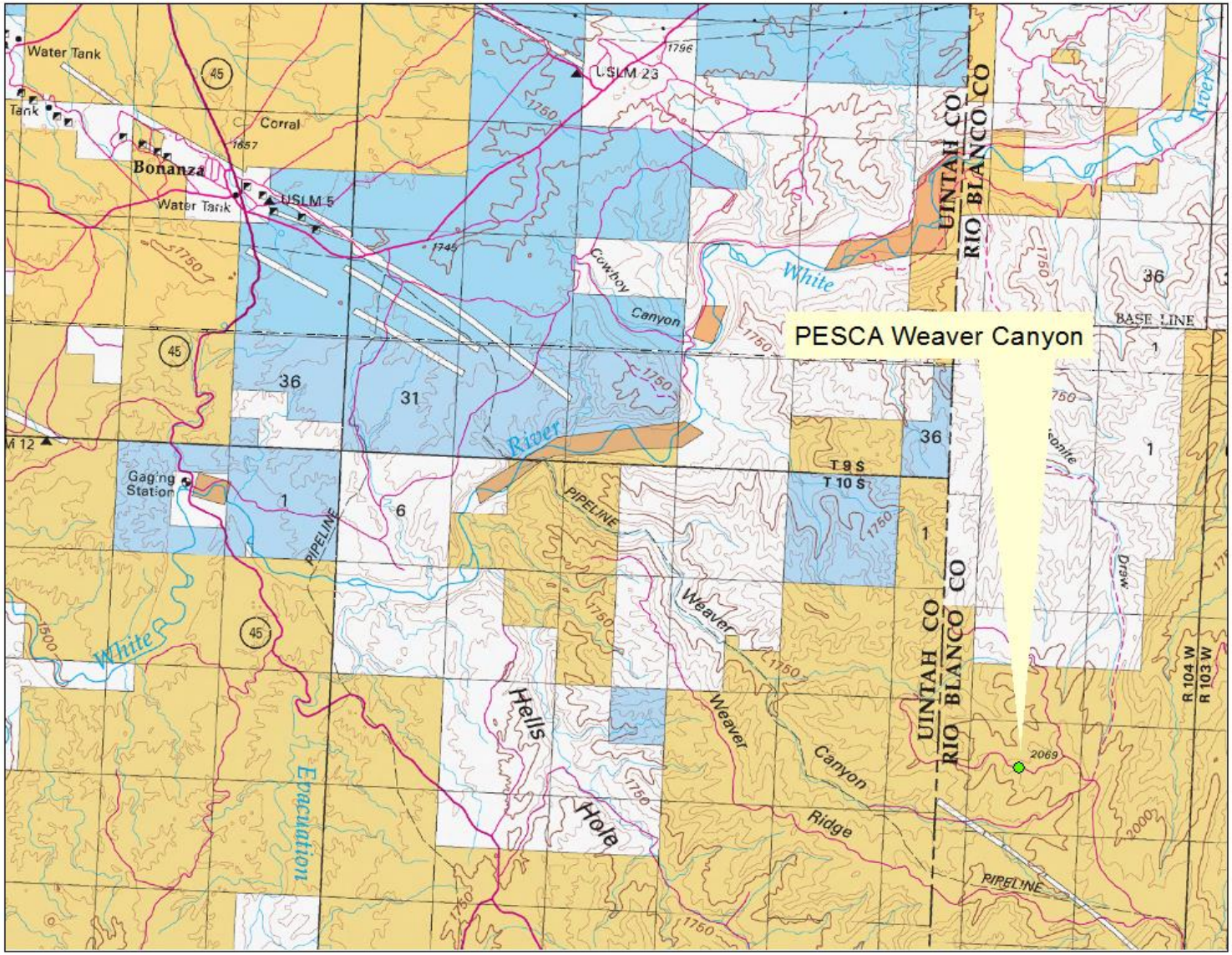

Figure 16. BLM – Colorado Weaver Canyon monitoring site in Conservation Unit 4 (White River)