Survey for precocious milkvetch (*Astragalus proimanthus* Barneby) in southwestern Wyoming

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Abstract

Field surveys for precocious milkvetch (*Astragalus proimanthus*) were conducted in 2015 using three information resources to locate a new population, expand the easternmost outlier population, and add to the negative survey data for this species. Soils data was compiled to help characterize habitat requirements, and new collections were made to better document the species and its habitat.

Acknowledgements

This report is an update that reflects and builds upon earlier reports on precocious milkvetch prepared by Walter Fertig and Laura Welp for Wyoming, 2001. I would like to thank Bonnie Heidel and Joy Handley (Wyoming Natural Diversity Database, WYNDD) for providing support to the field survey. The field survey and the preparation of this report was supported by the Bureau of Land Management – Rock Springs Field Office and Wyoming State Office, in collaboration with Wyoming Natural Diversity Database.

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Cover Photograph: *Astragalus proimanthus* by Marcel R. Jouseau

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Introduction

A status report on precocious milkvetch (*Astragalus proimanthus* Barneby) was prepared for the BLM Wyoming State Office in 2001 (Fertig & Welp 2001) based on field surveys, monitoring, and synthesis of all available information and knowledge of the species. Since that time, potential distribution models have been produced (Fertig and Thurston 2003, Andersen et al. 2016) and other sensitive species surveys conducted in the area (Jouseau 2012). The purpose of the field survey described in this report was to use potential distribution output, existing environmental information, and investigator expertise to conduct expanded field surveys for *A. proimanthus* and expand information on its distribution and habitat.

Study Area

This study area is located in southern Sweetwater Co. and eastern Uinta, an area of approximately 25 miles east to west and 8 miles north to south, see Fig. 1. The reader is referred to Fertig and Welp (2001) for an overview of the study area. More detailed information on soil conditions is detailed as part of results (this report).

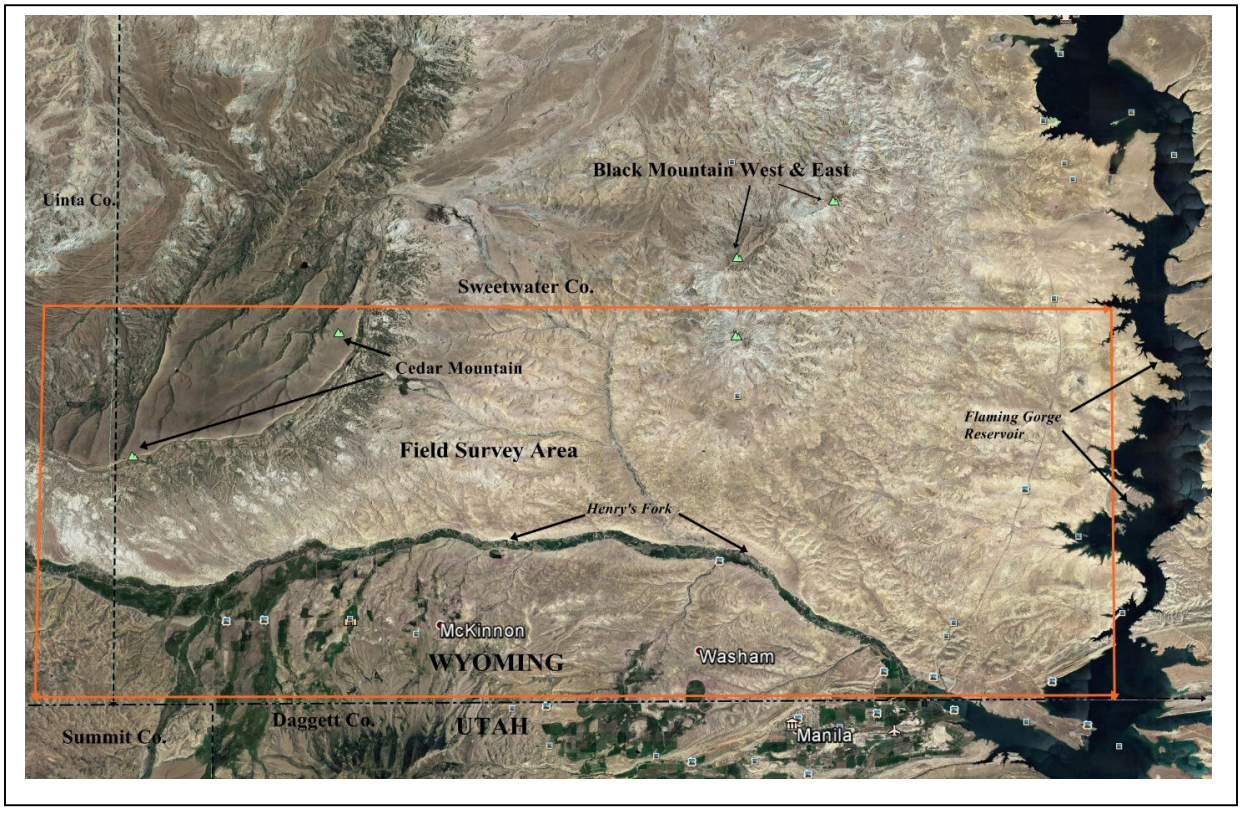


Figure 1. Survey area -- base photograph from Google Earth.

The Henry's Fork River runs through the study area, dissecting the expansive steppe landscape, bordered by low promontories in the vicinity named as mountains (Figure 2).

Figure 2. General view of survey area. By Marcel Jouseau

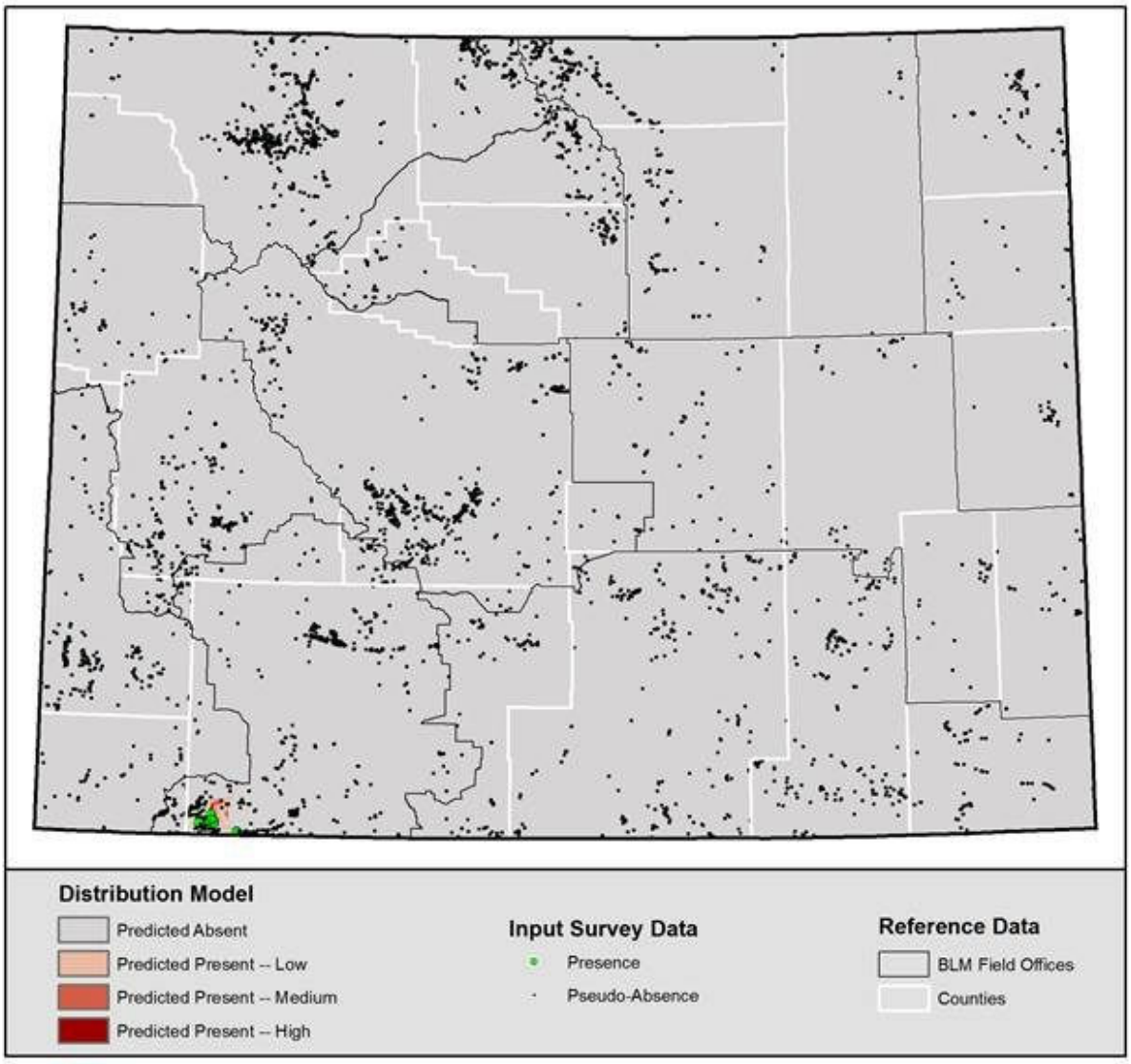


Figure 3 - Map of the potential distribution of *Astragalus proimanthus* (Andersen et al., 2016)

Methods

Three primary information resources were used in conducting *Astragalus proimanthus* field surveys:

1. The status report by Fertig and Welp (2001), which provides a complete record of where the species is known, and where it was sought but not found. Printouts and maps from this prior work were used in the 2015 study.
2. Re-checking herbaria records of *A. proimanthus*, including NYB, RM, RSA, BRY, US, UVU). Information on 20 vouchers of the precocious milkvetch was collected from the various herbaria and collated.
3. Potential distribution models for *A. proimanthus* (Fertig and Thurston 2003, Andersen et al. 2016). – see Figure 3 for the latter. Staff of WYNDD provided a digital copy of appropriate USGS topographic maps with the boundaries of the predicted niche of *A. proimanthus*.

The field survey was undertaken during the period of May 18 to May 27, 2015. These dates corresponded with early to peak blooming period for the taxon to facilitate the surveys. Areas selected were surveyed on foot and presence/absence points of the taxon were recorded with a global positioning system (GPS) receiver Magellan Meridian Gold model. The GPS unit was loaded with topographic maps showing not only elevation contour lines but also all roads, including forest roads, streams and other features allowing the surveyor to assess one's location relative to the landscape seen. Besides presence/absence records, notes including dates, points recorded, whether taxon present or absent, brief observations about the terrain and soils were recorded in a field notebook. Additionally, pictures of the soil, slopes or plant were collected and synchronized with the GPS coordinates so that they could be displayed together with the locational data in ArcView 3.3, ArcGIS, or QGIS. The GPS unit recorded at all time the route hiked by the surveyor by recording every 10 meters the location of the surveyor, thus providing a detailed electronic trace of the areas actually surveyed. The presence/absence point files and track files were saved in the field on a removable digital flash drive in the GPS. The name of each file was also recorded in the field book. Each evening, the data collected during the day were copied onto a laptop to provide a second copy of the data for safe-keeping, as well as to visualize the data with ArcView 3.3, a GIS software, on aerial photo to determine the quality of the data and extent of the area surveyed. Voucher specimens of *A. proimanthus* were collected in areas believed to be unknown populations or colonies at that time. All specimens were deposited at the Rocky Mountain Herbarium (RM) in 2015.

Results

One new population of *Astragalus proimanthus* was documented, and one of the three original populations was expanded across two additional sections in five areas (Figure 4). The new location lies south of Henry's Fork in T12N-R110W-Sec 5. The western most colonies were expanded with a new location within previously documented records in T13N-R111W- Sec 32. The easternmost occurrence was expanded in T12 N- R109W- Sec 17 & 16; T12 N-R110W-Sec 5. An electronic copy of all 2015 survey digital GPS tracks, presence-absence points, 85 pictures in the field of soil, slopes or plants, and label information from specimen vouchers sent to RM Herbarium were recorded on a CD and delivered to WYNDD. Known element occurrences and 2015 discovered occurrences or colonies are described in Appendix-A which is made part of this report. Topographic maps incorporating the traces of the 2015 survey routes (GPS tracks) are displayed in Appendix-B, attached to the report. Appendix-C to this report contains the printout of a Microsoft Excel spreadsheet that displays the specific locations of where each of 85 geo-referenced photographs was taken that includes the waypoint (site) number, photograph number, geographic coordinates in decimal degrees, datum WGS 1984 and in Universal Transverse Mercator (UTM), Zone 12 North, datum 1927 coordinates. The digital spreadsheet can be easily digitally-joined to the appropriate attributes table in a geographic Information System software such as Arcview 3.3, ArcGIS or QGIS, thus

allowing one to view each plant or habitat within the context of the geographic and topographic environment provided in a GIS project. Finally, Appendix-D to this report displays the specific information to be included on the label for each of the nine specimens of *A. proimanthus* sent to the Rocky Mountain (RM) herbarium.

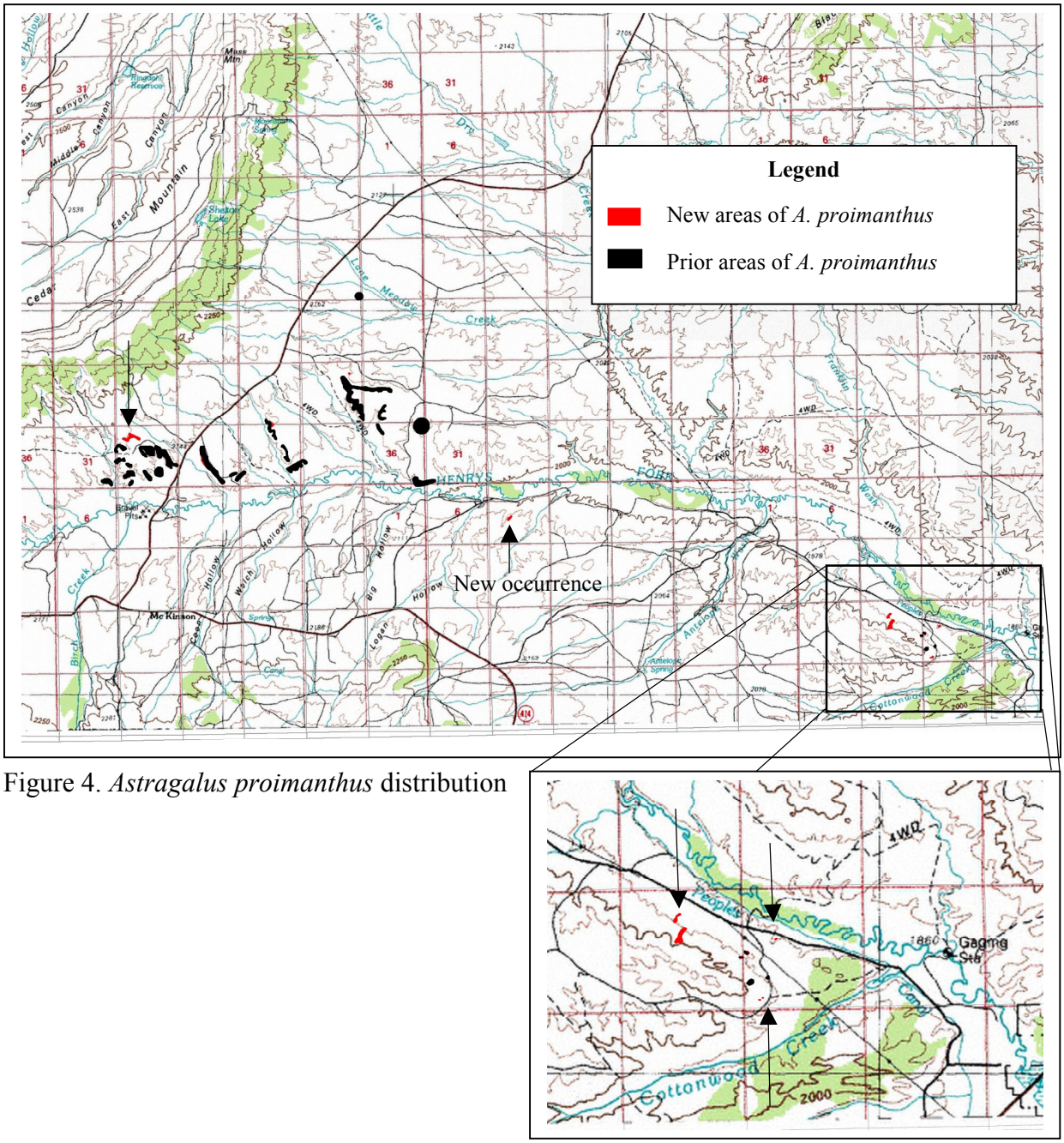


Figure 4. *Astragalus proimanthus* distribution

The reader is referred to the Fertig and Welp (2001) report for the bulk of species information. The 2015 field survey and supporting work expanded documentation in select topics that represent elaborations, discussions or updates to the prior work.

Description: Densely cespitose or pulvinate low convex cushions. Leaves silvery hirsute; leaflets equally pubescent on both upper and lower surfaces. Stipules hyaline, lanceolate or ovate 7-12mm long. , leaves 1.5-3.5 cm long, the petiole slightly widened at the base. Leaf composed of three leaflets 5-9 mm long. Flowers sessile or on almost non-existent peduncle, in axillary pairs. Calyx 8-10.5 mm long, densely white hirsute; tube cylindric or cylindro-campanulate about 6 mm long and about 3-4 mm in diameter. Petals white or pale lemon yellow, glabrous; the banner (upper petal), glabrous on the back, erect, somewhat fiddle-shaped, 12-17 mm long and 5mm wide, substantially notched at the apex; the claw and blade, somewhat oblong-oblanceolate, of about similar length; wings 11-16 mm long narrowly oblanceolate, obtuse (Barneby, 1964) . The apex of the banner may be marked with pink/purple veins, or be entirely white/pale lemon yellow. See Figures 5 & 6. Fruit pods are sessile, 7-10 mm long, narrowly elliptic to ovoid, slightly flattened from the sides, densely fine-hairy, and have 11-14 ovules; (Roberts, 1977; Isely, 1998).

Figures 5 & 6. Banner (upper petal) of *Astragalus proimanthus*, showing shape and color variation. By Marcel Jouseau

Phenology: Label information on vouchers for *A. proimanthus* in herbaria indicates that 15 out of 17 specimens were collected while the plant was flowering. Those specimens were collected as early as May 5 and as late as June 28. Six of the records 17 records were collected from June 3 to August 4, while the species had reached fruiting stage. In 2015, the author collected nine vouchers during the period May 22 to May 26. The taxon was in bloom at all collection points.

Flowering stage likely begins in late April and continues through early June to be followed by the main fruiting period from mid-June to August. However, year to year weather variations, altitude and slope orientation all contribute to variations in phenological stages of the species.

In 2008-2011, while surveying for *Penstemon acaulis* var. *acaulis*, this author noted that, at the beginning of the season, plants of this taxon found at about 6,400 ft were flowering 4 to 5 days earlier than those found at about 6700-6800 ft.

Abundance: In 2000, the total numbers within the three extant occurrences were estimated at between 10,500 and 13,200 plants. During the 2015 survey a roughly- estimated total of 500 additional individual plants were found.

Habitat: Sparsely vegetated cushion plant communities, in sagebrush or juniper openings, on shallow to steep slopes of clayey gravelly soils mostly derived from the Bridger Formation. The precocious milkvetch is often associated with *Artemisia, Cryptantha, Haplopappus, Agropyron*, and *Eriogonum* but also in areas almost devoid of vegetation.

Many of the labels of specimens of *Astragalus proimanthus* filed in herbaria provide a small amount of information on the soil in which the species was found. From those pieces of information one can deduce that specimens were often found on soils derived from shale and occasionally from sandstone parent material.

Southern Sweetwater County, the area subject of the modeling for the presence of *A. proimanthus*, is considered a very arid region, generally not suited for crop farming. Consequently federal and state agencies have put few resources into the development of soil data for the area. An exception is the Henry's Fork area where a soil survey was recently produced (USDA NRCS 2016). Henry's Fork and various canals provide water for land irrigation that has led to fairly intensive farming. The soil survey for the Henrys Fork Area, Utah- Wyoming -- Parts of Daggett and Summit Counties, Utah and Sweetwater and Uinta Counties, Wyoming, was published in 2004 and became available on-line in 2016 (USDA NRCS 2016).

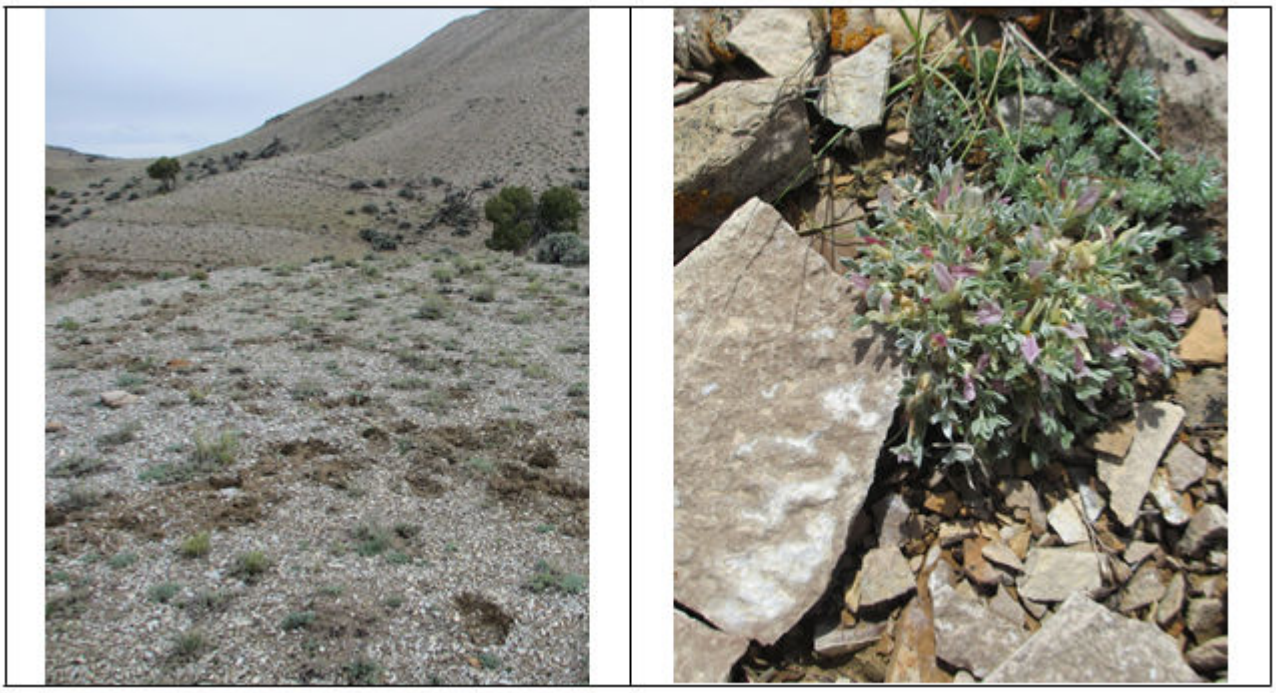
Polygons of known populations of *A. proimanthus* and data points collected in 2015 for new locations of presence of the species were superimposed on the digital soil survey of the Henry's Fork Area in a GIS. The intersection of those polygons and points of presence of the species with the soil polygons provided information on the soils where *A. proimanthus* has been found to grow. Maps of those intersections of the plant species and soils are presented as Figures 13-16, and maps of soils near *A. proimanthus* locales are shown in Figures 17-20.

Those intersections of the plant and soil data in the survey area show that *A. proimanthus* grows exclusively within a soil complex known as the "Blazon thin solum-Blazon-Lilsnake complex, 2 to 40 percent slopes". This soil complex is made up of 3 major soils: Blazon thin solum, Blazon and Lilsnake and 3 minor soil units: Rock Outcrop, Poposhia and Lilsnake like. Some of the characteristics of these soils are shown in Table 1.

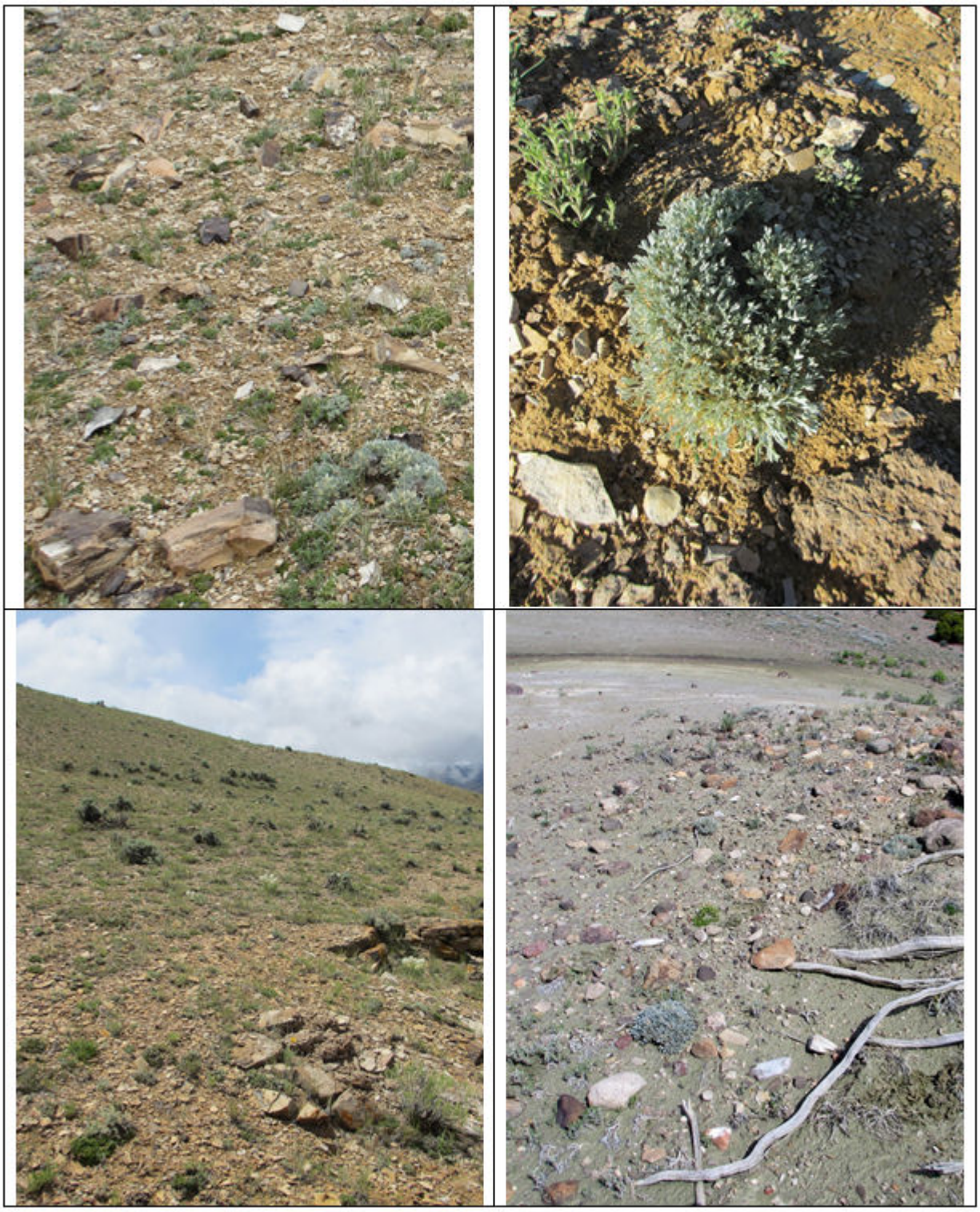
Table 1. Some characteristics of soils of the Blazon thin solum-Blazon-Lilsdale complex

Soil name & (% of the complex)	Blazon thin solum (30%)	Blazon (30%)	Lilsnake (20%)	Poposhia (7%)
Material	weathered from shale	weathered from shale	weathered from sandstone	alluvium from shale-sandstone
Depth to Bedrock	4-10 inches	10-20 inches	10-20 inches	>80 inches
Slope	6-40%	6-40%	2-10%	0-10%
Calcium Carbonate	up to 15%	up to 15%	up to 50%	up to 15%
Gypsum	up to 4%	up to 5%		up to 3%
Salinity	very slight to slight	very slight to slight	none to very slight	none to very slight
Water storage in profile	very low	very low	very low	high
pH	7.9-9.0 7.9 - 9.0	7.9-9.0 7.9 - 9.0	7.9-8.4 7.9 - 8.4	7.9-9.0 7.9 - 9.0
Clay content	15-27%	28-35%	18-27%	15-27%
Gravel content	<10% 30 - 45%	<10% 10 -20%	<15% <15%	<10% <10%
Available Water Capacity (In/In)	0.16 - 0.18 0.19 - 0.21	0.19 - 0.21 0.19 - 0.21	0.14 - 0.16 0.10 - 0.12	0.14 - 0.17 0.14 - 0.20
Organic matter content	0.5 -1%	0.5- 1%	<0.5%	1-2%

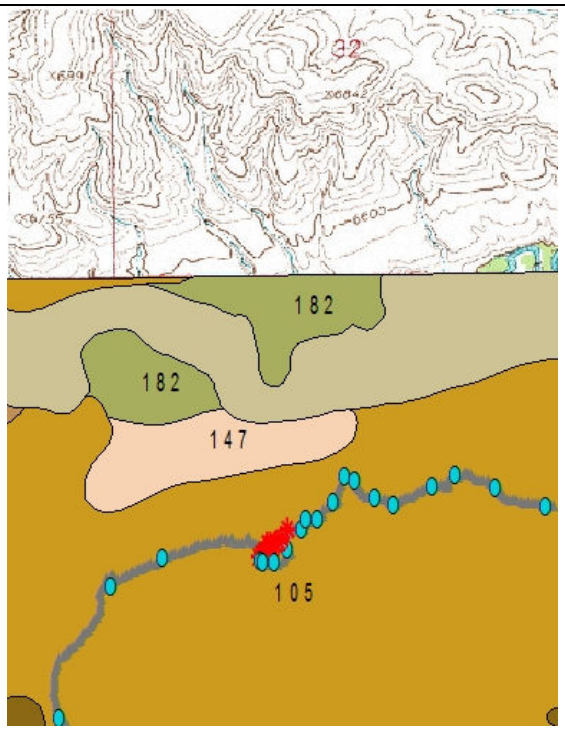
The proximity of several colonies of *A. proimanthus* to the limits of the Henrys Ford Area soil survey allows one to speculate that those colonies are likely also growing in the Blazon thin solum-Blazon-Lilsnake soil complex (Figures 17-20). This speculation is further supported by the occasional notes on soil and slope attached to specimens of the species found in herbaria.



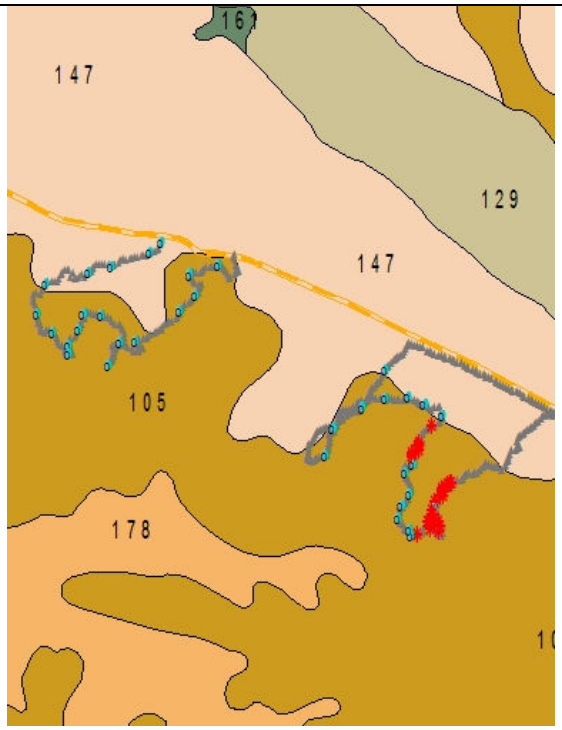
Figures 7 & 8. Characteristic soil conditions of *Astragalus proimanthus*



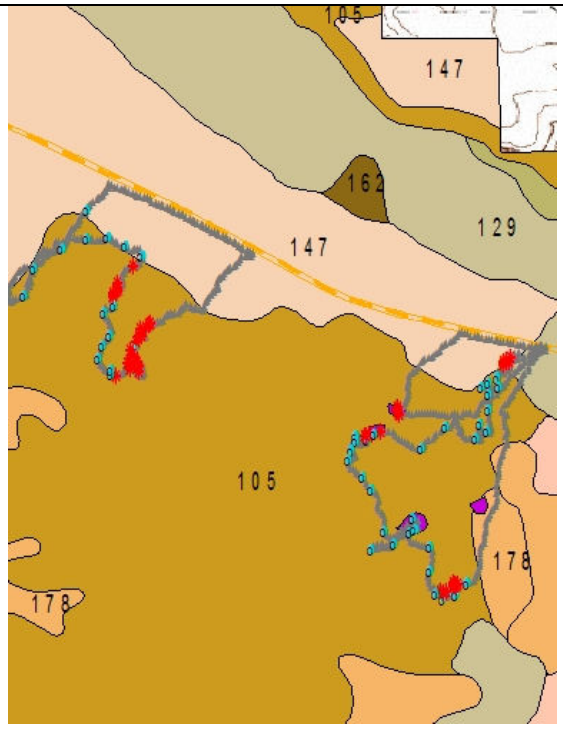
Figures 9-12. Characteristic soil conditions of *Astragalus proimanthus*



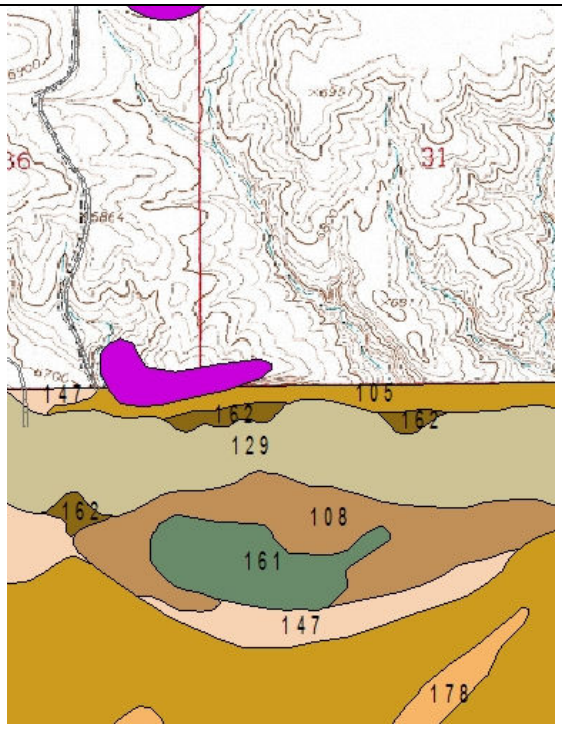
Soils in Section 5



Soils in Sections 17 & 18



Soils in Sections 17 & 16



Soils in Sections 31 & 36

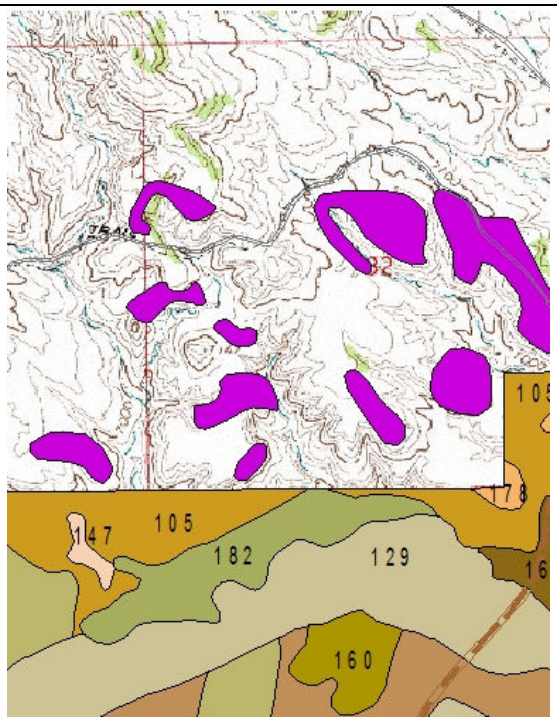
Legend

Soil types
105
129
147

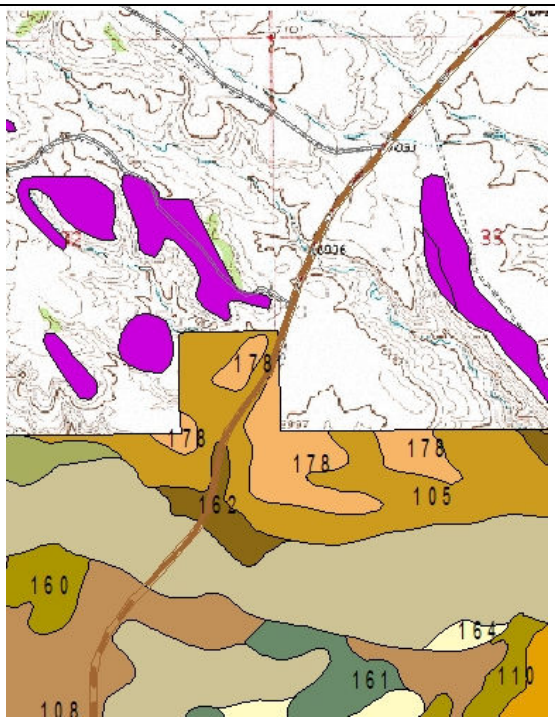
Species presence/absence
No
Yes
Survey tracks

Known species colony
Roads

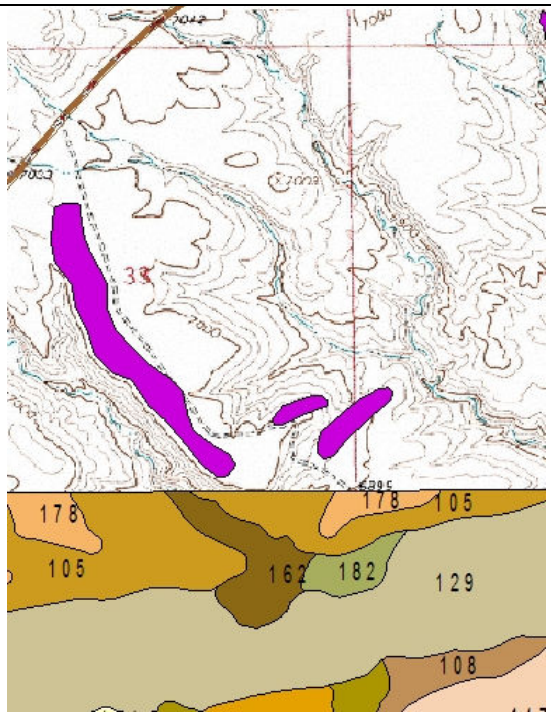
Figures 13-16. Soils mapped at *Astragalus proimanthus* locales



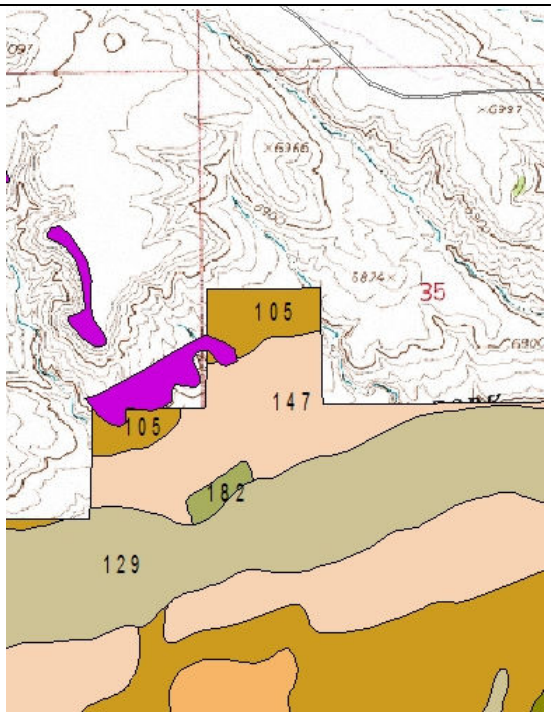
Soils in or near Sections 31 & 32



Soils in or near Sections 32 & 33



Soils in or near Sections 33 & 34



Soils in or near Sections 34 & 35

Legend

Soil types
105
129
147

Species presence/absence
No
Yes
Survey tracks

Known species colony
Roads

Figures 17-20. Soils mapped near *Astragalus proimanthus* locales

Threats: The precocious milkvetch populations, as known to date, occupy public land managed by the BLM and are located away from any major population center. Fertig and Welp (2001) noted the negative impact of a county landfill on a colony of the species. The 2015 survey did not provide further evidence of "urban" encroachment on the species. There was also no evidence of impact by recreational activities.

However, the wet conditions of 2015 suggested that the habitat can be impacted by cattle and wild horse trampling under some conditions. The most substantial impact was in the area of element occurrence 004 where horses (not present at the time) tore up the wet clayey soils.

Further, at the same location, a small slump had occurred leaving an area of about 100 ft by 200ft with a layer of very "liquid" clay several inches deep, devoid of any vegetation that was too impenetrable and unsafe for inspection. It was not possible to relate the animal activities and the landslide. It should be noted that despite extensive time and efforts it was not possible to relocate that very small population of precocious milkvetch but perhaps the few square meters in which the species grow were undisturbed but simply inaccessible at the time. Many of the various colonies of precocious milkvetch occur on very steep slopes that are susceptible to damage by grazing animals and also to natural slumping during prolonged rainy periods.

Discussion

Information at hand reinforces the interpretation that *Astragalus proimanthus* is an edaphic endemic and thus, soils data or directly related data has merit in documenting, maintaining and locating potential habitat. From a geobotanical standpoint, three areas should be the focus of any future surveys for *A. proimanthus*. The 2015 survey was limited in extent by the adverse weather conditions (snow, prolonged rains, fog). It would have been useful to attempt to link the new eastern colonies in sections 16, 17 and 5, on the north-facing slopes in the valley of the Henry's Fork, to determine whether other populations exist or whether occurrence 007 and the new colonies are in fact outliers. Similarly a search of the areas north and east of occurrence 004 extending to Twins Butte and to the east side of Flaming Gorge reservoir might have put the Barneby's plants, rediscovered by Welp in 2000, in a different geographical and ecological context. The south-facing area north of Henry's Fork also warrant a search as part of a corridor partly delineated by occurrences 001 and 007.

The areas south of occurrence 001 do not warrant any further search as the 2015 survey determined that the land beyond this population toward Burntfork, north and south of Henry's Fork, is far more densely vegetated and thus very unlikely to be occupied by precocious milkvetch that favors generally bare or nearly bare soils. Since the late 1990s much research on plant distribution has focused on the effect of corridors, or linear structures, on the distribution of plants, animals, insects and pollen (Tewskbury et al, 2002; Haddad et al., 2004; Nobis and Skórka, 2016). The linear corridor created by Henry's Fork valley together with the exposure of shale geologic formations and soils derived from those shales throughout the valley within the study area suggest that other sites suitable for colonies of precocious milkvetch could be found.

The 2015 fieldwork suggests that indeed there is potential habitat between the eastern and western distribution areas, but this possibility was not fully explored. The gap between eastern and western populations, and the two populations each known from a single point all warrant expanded survey. The positive and negative data collected in this study contributes to filling that gap.

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