

Beath Milkvetch (*Astragalus beathii*)

Monitoring Report Burro Canyon Monitoring Site 2005-2011

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INTRODUCTION

Beath milkvetch (*Astragalus beathii*) is an annual to short-lived perennial herb with a geographic range limited to several miles in the vicinity of Cameron, Coconino County, AZ (Roth 2004, Fig. 1). It is restricted to seleniferous soils derived from Moenkopi shale (Mikesic and Roth 2008). All known populations occur on Navajo Nation land. In 1980, the species was listed as a Candidate Species, Category Two, under the Endangered Species Act (45 FR 82480 *et seq.*). A subsequent status report by Brian and Phillips (1982) recommended that the species be removed from consideration as a candidate for listing as threatened or endangered. Justification for its removal was the species' abundance during years following wet winters and the large amount of potential habitat in northern Arizona.

Herbarium and field surveys by D. Roth in 2003-2004 revealed that the geographic range of Beath milkvetch is much more

restricted than supposed by Brian and Phillips. Herbarium specimens that had extended the species' range substantially northward were actually misidentified Preuss milkvetch (*A. preussii*). Much of the habitat once considered potential for the species was unoccupied, even though one of the survey seasons, 2003, followed a wet spring (Roth 2004).

Beath milkvetch is currently a candidate (G4) species under Navajo Nation Endangered Species law (17 N.N.C. §507). This means that the Navajo Natural Heritage Program actively seeks information on the species to determine if it warrants listing as threatened or endangered, or if it should be removed from the Navajo Endangered Species List (Navajo Nation Department of Natural Resources 2008). In 2005, the Arboretum at Flagstaff obtained a grant from the U.S. Fish and Wildlife Service to establish a monitoring site for Beath milkvetch on the Navajo Nation. Funding for this project was discontinued in 2006 and the Navajo Natural Heritage Program has been monitoring the Burro Canyon population ever since. This document is an update of the most recent monitoring report for this population (Roth 2009), which reflects the data collected during the spring of 2011. The Burro Canyon population was not monitored in 2010, because the NNHP lacked a botanist that year.

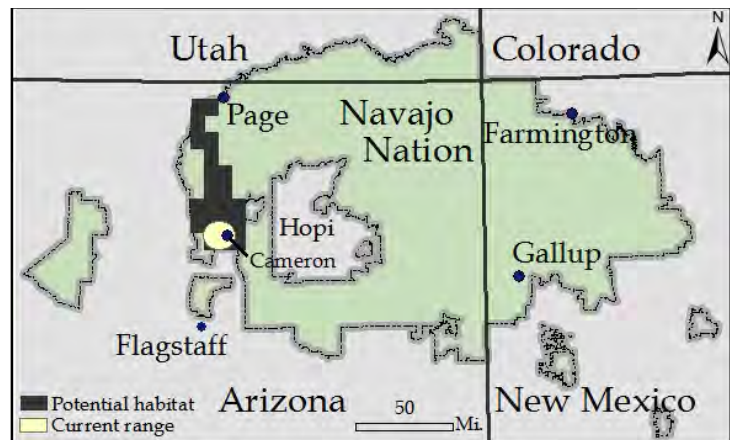


Figure 1. Location of Beath milkvetch populations and potential habitat, based on presence of Moenkopi formation soils, in Coconino County, AZ.

METHODS

Five monitoring plots were established in Burro Canyon, ca. 5 miles southwest of Cameron on April 26, 2005. Each of the 5 plots measures 5m x 5m and all 4 corners are marked with rebar stakes. All plots were mapped using GPS units and coordinates for the SE corner of each plot were recorded. Each year, the total number of plants, number of plants older than one year, number of plants that are reproductive, and number of dead plants are recorded for each plot.

RESULTS

Observations in 2011

In 2011, Beath milkvetch plants were found in only two of the five monitoring plots. A total of 21 plants were found in plot five. Thirteen of these were reproductive. All plants in the plot had been grazed by ungulates (Fig. 2), so it is possible that the eight individuals that were recorded as sterile had produced reproductive structures before being eaten. Reproductive plants bore flowers past anthesis, immature fruit, and mature fruit at the time of the site visit on 3 May. A high proportion of the plants (16 of 22) were considered perennial, or older than one year. One other plot, plot three, contained one Beath milkvetch seedling and no adults.

Although no Beath milkvetch was present in plots one, two, and four, small populations of the species did occur adjacent to all of those plots. Another cluster of about 60 Beath milkvetch was observed one the terrace above the wash, about 250 meters east of the monitoring plots.

In addition to the widespread grazing by ungulates, one Beath milkvetch plant was also observed as having been grazed by rodent (Fig. 3). At the time of the site visit, Beath milkvetch was the only fresh, green plant present in abundance (Fig 4). Most individuals had been grazed to a height of 15-25 cm. Other dominant vegetation in the site included four-wing saltbush, Russian thistle, sandhill muhly, snakeweed, rabbitbrush, and Mormon tea. The few herbaceous species, which were present in low abundance, included wild heliotrope, prince's plume, broadleaf milkweed, and blue stem prickly poppy.



Figure 2. Beath milkvetch that has been grazed by an ungulate. The plant height is between 10 and 15 cm. The diameter of the camera lens cap is 7cm. Plant located just north of Burro Canyon monitoring plot #1. Photo taken 3 May 2011.



Figure 3. Beath milkvetch that has been recently grazed by a rodent. Plant located just west of Burro Canyon monitoring plot #1. Photo taken 3 May 2011.



Figure 4 (left). Beath milkvetch monitoring plot #5 at Burro Canyon. Red pinflags mark plot corners and individuals of the species. Additional Beath milkvetch plants, outside the plot, are visible in the left foreground. Photo taken on 3 May 2011.

Trends over time

After the exceptionally wet winter of 2004-2005, the Beath milkvetch population in Burro Canyon consisted of hundreds of plants, most of which were sterile annuals (Figs. 5, 6, 7, and 8; Table 1). None of these plants survived until April of 2006, when no Beath milkvetch were found in any of the monitoring plots. In 2007, the population remained low, with 15 plants found, all of which were annuals and only one of which was reproductive. By 2008, two of those plants survived as perennials, and 85 additional annuals germinated. Only the two perennial plants were reproductive that year. By 2009, all Beath milkvetch plants had died.

The winter of 2009-2010 was wet, but the Burro Canyon plots were not monitored that spring. The following spring, 2011, 16 perennial plants remained as evidence of the wet winter the year before, and there were six additional annual plants in the plots as well.

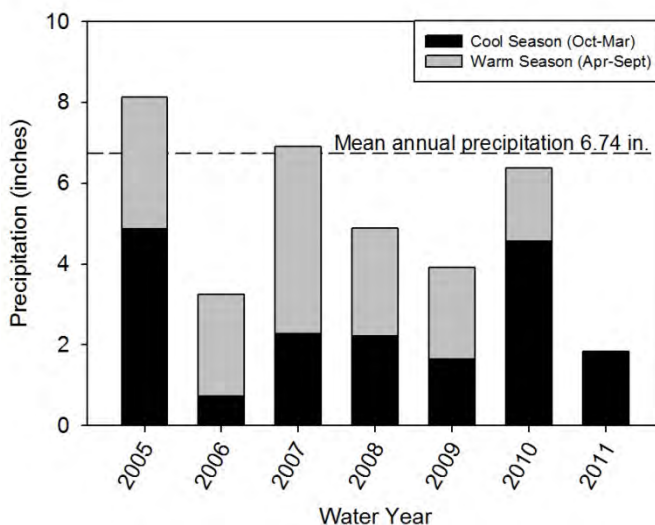


Figure 5. Total precipitation in Tuba City, coded by cool season (October to March) and warm season (April to September) for water years 2005 – 2011. Mean annual precipitation is a 30-year average, calculated from the years 1981-2010. Data from NOAA. Warm season data for 2011 is not displayed because it is not yet available.

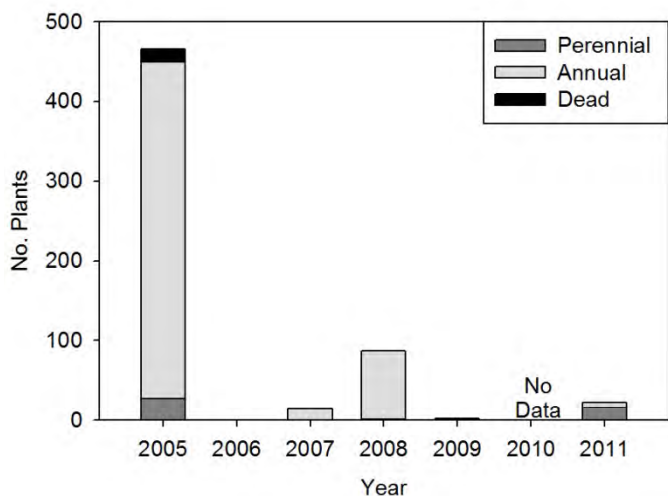


Figure 6. Total number of Beath milkvetch, coded as first year plants (annuals), plants older than one year (perennials) and dead plants, in five monitoring plots in Burro Canyon, 2005-2011.

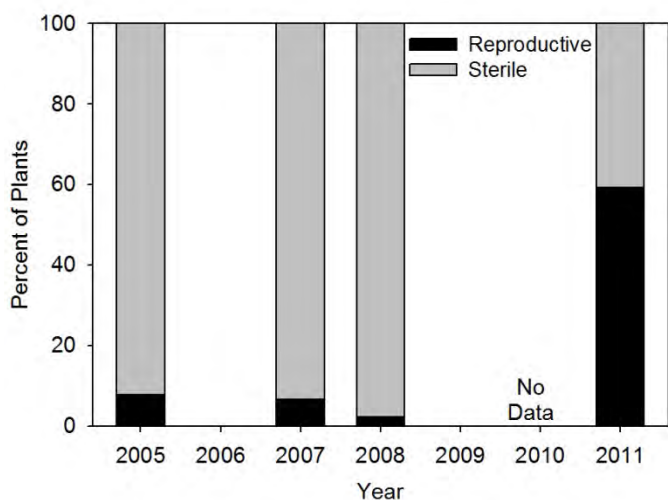


Figure 7. Proportion Beath milkvetch with reproductive structures in five monitoring plots at Burro Canyon, 2005-2011.

Table 1. Summary of Beath milkvetch demographic data from five Burro Canyon monitoring plots, 2005-2011.

Year	Total Alive	Perennial	Reproductive	Dead
2005	449	27	35	17
2006	0	0	0	0
2007	15	0	1	0
2008	87	2	2	0
2009	0	0	0	2
2010	----- No Data -----			
2011	22	16	13	0

DISCUSSION

The available information on the natural history of this species, combined with the trends presented in this monitoring report, suggest that Beath milkvetch embodies the classic, disturbance-adapted ecological strategy. The plant is short-lived, sometimes flowering in the first year. It responds strongly to moisture availability, both spatially and temporally; it germinates in high numbers during wet years, and occurs most often in washes and along roadsides. Both of those habitat types are characterized by high levels of resources, especially water, as well as high levels of disturbance, compared to surrounding areas. Like other “pioneer”, or early successional species, Beath milkvetch germinates in bare soil and full sun, as opposed to beneath a nurse plant. It forms a seed bank which is viable for several years at least. This is evident from the presence of plants in Burro Canyon in 2011 despite the lack of reproductive individuals for the previous few years.

Unlike typical ruderal species, Beath milkvetch is highly restricted geographically. This can be partly attributed to the fact that it is an edaphic obligate, occurring only in soils derived from Moenkopi formation. However, Moenkopi formation is widespread in northern Arizona, and most of the appropriate habitat for Beath milkvetch, as we understand it, is unoccupied. In order to better understand the causes of this species' rarity, additional studies need to be conducted. Information that may be of use in understanding this species' ecology includes:

- Chemical and textural analysis of soils where Beath milkvetch occurs, and comparison with similar soils where the species is expected to occur but is absent.
- Studies of the species' seed dispersal syndrome. What is the dispersal mechanism for the fruits/ seeds? What is the average distance that the seeds travel? At what rate do seeds arrive at appropriate germination sites? If animals are a primary agent of seed dispersal, are the fruits eaten? Are seeds destroyed in the animals' digestive tract, or do they remain viable?
- What is the longevity and spatial extent of Beath milkvetch's seed bank? What is the germination rate of the seeds under favorable conditions?

Because Beath milkvetch is so short-lived and mobile, traditional plant monitoring methods are less effective for tracking its abundance from year to year. In the future, larger monitoring plots and additional monitoring locations will be incorporated into the study design.



Figure 8. Beath milkvetch in Burro Canyon during April 2005. Photo: D. Roth

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ACKNOWLEDGEMENTS

This report was adapted from previous monitoring reports written by D. Roth, former botanist for the Navajo Natural Heritage Program. Data collected by D. Roth, other staff of the NNHP, and the Flagstaff Arboretum, from 2005-2009 were used to generate figures and determine trends for this monitoring report.