Copper Canyon Milkvetch (*Astragalus cutleri*)

2011 Monitoring Update

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INTRODUCTION

Copper Canyon milkvetch *(Astragalus cutleri)* is an annual to short-lived perennial herb with a geographic range limited to a few canyon tributaries to the San Juan River in San Juan County, Utah (Fig. 1) The species was first described as a variety of *A. preussii* by R.C. Barneby (published in Welsh 1986) and later raised to species level by Welsh (1998). Copper Canyon milkvetch is listed in Group 2 (endangered) of the Navajo Endangered Species List (Navajo Nation Division of Natural Resources 2008). It is not protected under the Federal Endangered Species Act.

There are few known populations of this species; one is located on the south side of the San Juan River, on the Navajo Nation, near the mouths of Copper and Nokai Canyons. Another is on the north side of the river, in the National Park Service's Glen Canyon National Recreation Area. A collection by Atwood from 1997 places this species near the Clay Hills boat takeout upstream of Copper and Nokai Canyons as well.

Figure 1. General location (shown in yellow) of Copper Canyon milkvetch populations in San Juan County, Utah.

The sites where Copper Canyon milkvetch have been found are characterized by sandy, seleniferous soils on the Shinarump and Chinle geologic formations (Mikesic and Roth 2008). The species occurs in warm desert shrub communities, at elevations around 4,000 feet (Atwood *et al.* 1991).

The Navajo Natural Heritage Program has been tracking Copper Canyon milkvetch on the Navajo Nation since 1990. Throughout the 21 year span that that NNHP has monitored this species, population sizes have fluctuated widely. Some years, hundreds to thousands of plants were present in Copper and Nokai Canyons, and during other years, none could be located. In the most recent status report on the species, D. Roth attributes this variability to two causes: grazing pressure by feral burros (*Equus asinus*), and variability in rainfall (Roth 2010).

The objectives of this this year's work on Copper Canyon milkvetch were:

1. Continue the monitoring program that has been in place since 2005, in order to track population fluctuations over time in a structured, consistent manner.
2. Expand the monitoring program to encompass a larger area than is captured by the previously established monitoring plots.
3. Document the existence, magnitude, and source(s) of grazing pressure on Copper Canyon milkvetch.

This monitoring report presents and analyzes the results of this year's work in the context of the 21-year history of monitoring data on this species.

METHODS

Monitoring plots
In 2005, the NNHP botanist established two monitoring plots near the mouth of Nokai Canyon (Fig. 2). The plots measured approximately 0.5 acres each. Each year, plots are visited in early May. The number of living and dead Copper Canyon milkvetch plants in each plot is tallied, and reproductive stage and age are noted for each living plant. The general condition of the plants and landscape are noted as well (e.g. associated species, insect damage, evidence of grazing). Plots were most recently monitored on May 5, 2011.

Road transect
In addition to monitoring the existing plots, the monitoring program was expanded in 2011 to include plant counts along a road transect. This was deemed necessary because Copper Canyon milkvetch has a short life span and grows in slightly different locations from year to year. While monitoring plots were likely established in the densest parts of the population in 2005, higher densities of the plants now grow in locations outside, but near to the monitoring plots.

There is one four wheel drive trail that leads through Copper Canyon from the upstream end to the mouth of the canyon. Just before reaching the San Juan River, the trail swings west around the northern tip of No Man's Mesa and continues to the mouth of Nokai Canyon. On May 5, 2011, botanist L. Begay assisted me in conducting plant counts along the northernmost 7 km of this road, a stretch that runs from a fence that crosses lower Copper Canyon, north and west to the Nokai Canyon monitoring plot (Fig. 2).

The truck was driven down the road at idling speed while both botanists searched the roadsides for Copper Canyon milkvetch plants. When a plant was spotted, both botanists would hop out of the truck and count the number of plants in the population, within 150 meters of the road.

Grazing Pressure
Grazing pressure was assessed during three visits to the Copper and Nokai Canyon population in 2011. On March 29-30, 2011, University of New Mexico wildlife biologist P. Polechla accompanied me to Copper Canyon in order to help document the grazing situation in the canyon. Dr. Polechla has extensive experience as a tracker as well as working with feral and domestic equids. While I searched for Copper Canyon milkvetch, Dr. Polechla recorded the number, condition, and species of ungulates that we observed in the canyon. He also recorded additional evidence of animal life in the canyon (tracks and scat).

During this early spring visit, one ad hoc grazing impact plot was set up; the two existing monitoring plots were also sampled for grazing impacts on that date. Within each of these plots, the number of Copper Canyon milkvetch plants that were grazed vs. ungrazed was tallied.

On May 5, 2011, L. Begay assisted me in repeating the grazing tallies in the two established monitoring plots. The ad hoc plot from March was not re-sampled because its precise location had not been recorded.

On October 21, 2011, L. Begay again assisted me in assessing grazing pressure to the Copper Canyon milkvetch population. The No Man's Mesa monitoring plot was revisited and all remaining plants that were recognizable as Copper Canyon milkvetch were recorded as dead or alive, along with an assessment the level of grazing each plant had experienced during the growing season. Two grazing pressure categories were used: (a) heavily grazed and (b) retaining fruit stalks. Plants were categorized in group (b) if the fruit stalks for that plant were still attached or if (in the case of some dead plants) the stalks lay on the ground adjacent to the plant in an orientation such that it was obvious that they came from that plant.

RESULTS

Monitoring Plots
In May of 2011, a total of 108 Copper Canyon milkvetch plants were recorded in the two monitoring plots (Table 1). Of these, 103 were in the monitoring plot north of No Man's Mesa and only 5 were in the monitoring plot at the mouth of Nokai Canyon. Compared to the previous year, there was a decrease in plant numbers in both plots. The decline was more pronounced in the Nokai Canyon plot, however; in 2010 there were 138 plants in that plot, most of them annual. The five plants that remained in that plot in 2011 were all perennial survivors from 2010, two of which were reproductive that year.

In 2011, the majority (83%) of the plants in the No Man's Mesa plot were perennial survivors from 2010, and 84% were reproductive. At the time of the early May site visit, most plants bore immature to mature fruit; a few still bore flowers as well.

There were greater numbers and a higher proportion of perennial survivors in 2011 than in any other year since monitoring plots were installed (Table 1, Fig. 2). In 2011, Copper Canyon milkvetch plants also had the highest rate of reproduction of any year in the monitoring study (Table 1, Fig. 3).

Since 2005, total number of plants in the monitoring plots has fluctuated from as high as 501 to as low as 19. Changes in the total number of Copper Canyon milkvetch recorded in monitoring plots appears to correlate with the amount of precipitation the area received the previous winter (Figs 4, 5). While this trend can be detected visually, sample sizes are too small to analyze the relationship statistically.

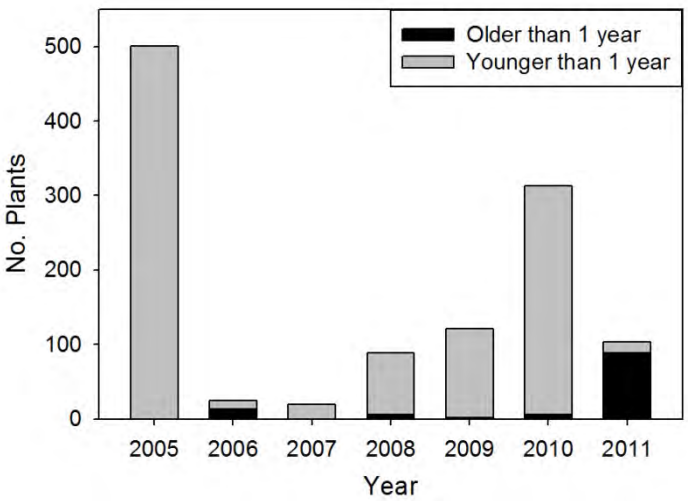

Figure 2. Age class distribution of Copper Canyon milkvetch plants in two one-half acre monitoring plots sampled in early May, 2005-2011.

Table 1. Total number, number reproductive, and number older than 1 year of Copper Canyon milkvetch recorded in two monitoring plots in the vicinity of Copper Canyon, UT in May, 2011.

Year	No. Live Plants	No. Reproductive	% Reproductive	No. Perennial	% Perennial
2005	501	292	58	0	0
2006	25	8	32	14	56
2007	19	9	47	0	0
2008	89	11	12	7	8
2009	121	48	40	3	2
2010	313	87	28	7	2
2011	108	89	82	90	83

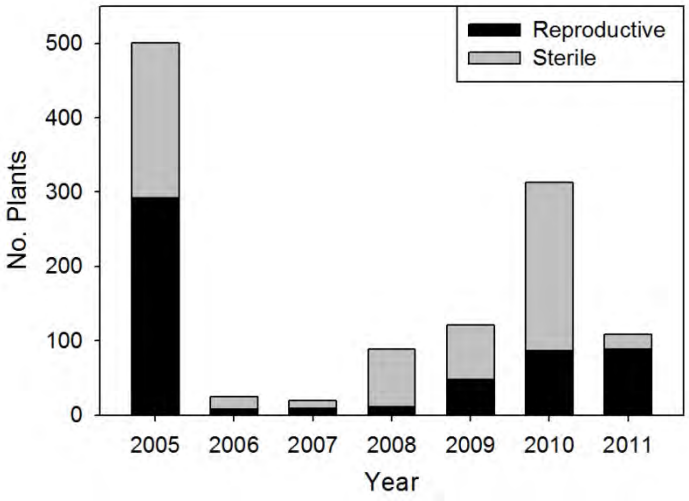

Figure 3. Reproductive status of Copper Canyon milkvetch plants in two half acre monitoring plots sampled in early May, 2005-2011.

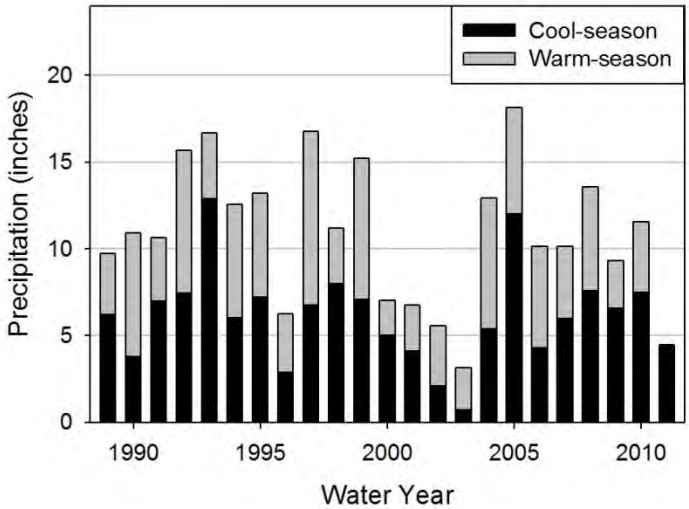

Figure 4. Total precipitation for the cool season (Oct-Mar) and warm season (Apr-Sept) of water years 1989-2011 at Betatakin, AZ, 40 miles south of Copper Canyon, UT (Western Regional Climate Center, 2011). Water years run from the October preceding the calendar year through September of the calendar year. Data is not presented for the warm season of 2011.

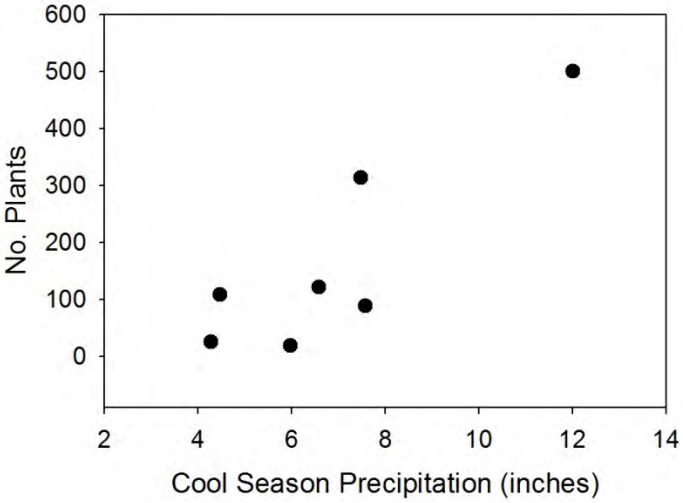

Figure 5. Total number of Copper Canyon milkvetch plants recorded in two monitoring plots in the vicinity of Copper Canyon, UT, as a function of precipitation recorded at the Betatakin, AZ weather station during the October to March preceding the sampling season.

Road transect

Throughout the years, NNHP staff has employed varying levels of survey effort in order to assess the status of Copper Canyon milkvetch. Table 2 shows the best estimate available of total numbers for the species each year that it has been surveyed. With the exception of 2005, total numbers for the species in a given year range from zero to several hundred. Notably, in the early 2000s the species was absent from Copper and Nokai Canyons. This temporary extirpation coincides with a series of years with low precipitation (Fig. 4).

In May 2011, 458 plants were found along the Copper Canyon road (Table 2). Most plants were clustered in 4 main populations north of No Man's Mesa. Approximately 50 of the plants were scattered between populations.

Most Copper Canyon milkvetch plants were observed growing directly along the edge of the road, between the tire tracks of the road, or at the bottom of small drainages, where it appeared that water had flowed in "rivulets" earlier in the spring (Figs 6, 7).

Table 2. Best available population estimates for Copper Canyon milkvetch and corresponding survey methods for years that it was surveyed by NNHP staff.

Year	No. Plants Found	Survey Type
1990	ca. 300	Inventory of potential habitat in Navajo Nation
1998	<100	Copper Canyon road survey
1999	1	Copper Canyon road survey
2000	0	Inventory of Copper and Nokai Canyons
2001	0	Survey of known locations in Copper and Nokai Canyons
2002	0	Survey of known locations in Copper and Nokai Canyons
2003	6	Inventory of Copper and Nokai Canyons
2004	ca. 80	Survey of known locations in Copper and Nokai Canyons
2005	ca. 2000 plants	Survey of known locations in Copper and Nokai Canyons
2006	25	Monitoring plots (2)
2007	19	Monitoring plots (2)
2008	89	Monitoring plots (2)
2009	121	Monitoring plots (2)
2010	313	Monitoring plots (2)
2011	458	Copper Canyon road survey

Figure 6. Copper Canyon milkvetch plants (circled in black) growing at the bottom of a small drainage north of No Man's Mesa, UT.

Figure 7 (left). Copper Canyon milkvetch plants growing in the middle of a 2-track road north of No Man's Mesa, UT. There are five individuals of the species in this frame; the two largest are circled in black.

Grazing Pressure

March 2011. During the March 2011 visit, two domestic (branded but unshod) horses (*Equus caballus*), 15 domestic cattle (*Bos taurus*), and 11 feral burros (*Equus asinus*) were observed between the upper extent of Copper Canyon and the Nokai Canyon plot. In the same area, a total of 35 old and fresh cow pies and 9 trails were observed, and 16 old and fresh burro scat piles and 8 trails. At one location near the confluence of Copper Canyon and the San Juan River, seven Copper Canyon milkvetch plants had been grazed by either a burro or a cow. At another location, north of No Man's Mesa, one instance was seen of burro tracks adjacent to a grazed Copper Canyon milkvetch plant.

One set of fresh burro tracks crossed the No Man's Mesa plot. Four ungulate-grazed milkvetch plants were located along that trail. Also within that plot were 3 cow pies, 11 piles of burro scat, 2 desert cottontail (*Sylvilagus audobonii*) pellets, and three pocket mouse (*Perognathus* or *Chaetodipus*) holes. The soil within this plot was too compact to register tracks from the lagamorphs and rodents.

Within the No Man's Mesa plot, 61 of 107 Copper Canyon milkvetch plants had been recently grazed (Fig. 8); however, the grazing pattern on most of the plants was consistent with that of a small animal such as a lagamorph or rodent, rather than that of an ungulate (Fig. 9). In March, the proportion of plants grazed by ungulates vs. rodents was not quantified.

The Copper Canyon milkvetch was one of very few green, herbaceous species present at the site during the March 2011 visit. Young rosettes of filaree (*Erodium cicutarium*), desert trumpet (*Eriogonum inflatum*), and scaly globe mallow (*Sphaeralcea leptophylla*) were also present in low abundance.

May 2011. During the May site visit, 5 cows and 6 burros were observed between the upstream extent of Copper Canyon and the Nokai Canyon plot. Piles of green milkvetch fruits and clipped stems were observed within the No Man's Mesa plot and across road from that plot (Fig. 10). During May, Copper Canyon milkvetch remained nearly the only fresh green vegetation present at the site. Some of the early spring herbaceous plants, such as filaree and red brome (*Bromus rubens*), had already died.

In May, 74 of 107 plants had been grazed. Of those 74 grazed plants, 28 had been grazed by ungulates and 46 had been grazed by rodents (Fig. 8).

October 2011. In October, the majority of Copper Canyon milkvetch plants had already senesced. Of the 62 plants within the Man's Mesa Plot that were still recognizable as Copper Canyon milkvetch, 10 were alive and 52 were dead (Fig. 8). A total of 38 of the 62 still-recognizable plants retained fruiting stalks with mature fruits still attached, and 24 had been grazed so heavily that no fruiting stalks remained. Taking into account the 41 plants which could not be located in October, a minimum of 37% of the plot's 103 plants retained fruit stalks long enough to set seed.

In October, four burros and three cattle were seen in Copper Canyon. There were burro tracks throughout the No Man's Mesa plot. During this visit, clipped snakeweed flowers and leaves were found where the caches of green milkvetch fruits had been located in May.

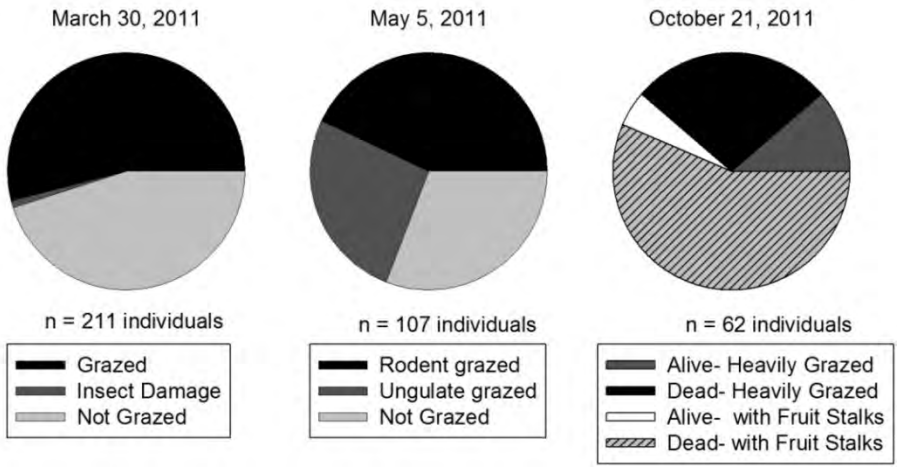

Figure 8. Percent of Copper Canyon milkvetch plants that had been grazed in 2011, during the beginning, middle, and end of the growing season.

Figure 9. Rodent-grazed Copper Canyon milkvetch. The black circle highlights stems that have been nibbled by a rodent or lagamorph.

DISCUSSION

Copper Canyon milkvetch is a short-lived plant; while the species can be perennial, seven years of monitoring data show that the vast majority of plants live for only one year. For such short-lived plants, keys to knowledge of the species' viability are germination and seed set rates. Because of the annual life span, survival is only important in as much as it allows seed set.

In the past, grazing and climate fluctuations had been identified as the two threats responsible for the wide variation in population size from year to year (Roth 2010). The seven years of monitoring data presented here show a strong relationship between cool-season rainfall and spring population size for Copper Canyon milkvetch. This relationship points to precipitation as the primary factor influencing annual germination and thus population size.

Grazing, on the other hand, would influence seed set rates. This could be due to the animal eating enough of the plant to kill or stress it so that it does not produce fruit, or by direct consumption of the fruits before seeds are mature.

Figure 10. Pile of green Copper Canyon milkvetch fruits and clipped stems.

Observations in 2011 suggest that mild to moderate grazing pressure from feral burros, and possibly domestic livestock, does exist. However, the majority of the grazing pressure was from an unidentified rodent or lagomorph.

Despite the multiple grazing pressures, at least 37% of Copper Canyon milkvetch from the No Man's Mesa plot retained their fruiting stalks long enough to set seed. The percent of plants that set seed is likely higher, however, because at the time of sampling, the plants had been dead for long enough to make them difficult to recognize.

One concern that arises from the reduced seed set is the possibility of a depleted seed bank. Copper Canyon milkvetch very likely produces seeds that remain viable for years in the soil, based on the fact that the Copper and Nokai Canyon population declined to zero for several years and then rebounded to several thousand in just two years. Survey data for twenty years do not show a decline in plant numbers over time, however, suggesting that the seed bank is not becoming depleted. Rather, population numbers are strongly tied to precipitation levels.

Because Copper Canyon milkvetch is such a narrow endemic, and because the presence of the grazing threat is confirmed, the Navajo Natural Heritage program will continue to monitor this population closely. Further research is necessary to determine whether grazing by feral and domestic ungulates, as well as by wild rodents, is lowering the long-term viability of this population and the species as a whole. Furthermore, in order to assess the status of the species as a whole, it will be necessary to survey potential habitat in nearby canyons for new populations.

As long as this population is closely monitored by the NNHP, management action against the feral burros should not be necessary until and unless the Copper Canyon milkvetch is shown to be truly at risk due to grazing by the burros. Based on my interpretation of historic and current monitoring data, there is not enough information to support such a claim.

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 Navajo Natural Heritage Program, the National Park Service, the Utah Natural Heritage Program, and the Bureau of Land Management, from 1990 to 2011 were used to generate figures and determine trends for this monitoring report.

Thank you to Paul Polechla and Leanna Begay for contributing their time and expertise to this project.

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